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ABSTRACT

This Unified Sciences and Mathematics for Elementary Schools (USMES) unit challenges students to find effective ways to manage and/or conserve school supplies. The challenge is general enough to apply to many problem-solving situations in mathematics, science, social science, and language arts at any elementary school level (grades 1-8). The Teacher Resource Book for the unit is divided into five sections. Section I describes the USMES approach to student-initiated investigations of real problems, including a discussion of the nature of USMES "challenges." Section II provides an overview of possible student activities with comments on prerequisite skills, instructional strategies, suggestions when using the unit with primary grades, flow charts illustrating how investigations evolve from students' discussions of problems, and a hypothetical account of intermediate-level class activities. Section III provides documented events of actual class activities from grades 2, 5, 6, and 8. Section IV includes lists of "How To" cards and background papers, bibliography of non-USMES materials, and a glossary. Section V consists of charts identifying skills, concepts, processes, and areas of study learned as students become involved with the activities. (JN)

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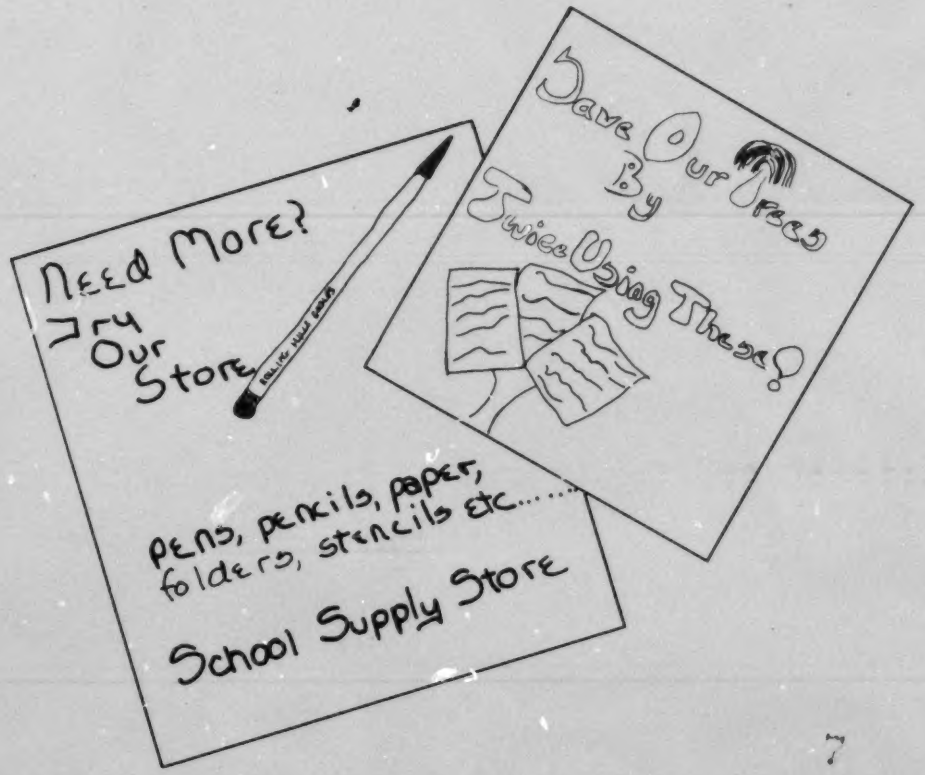
This book is a resource developed by the USMES Project: Earle L. Lomon, Project Director, Betty M. Beck, Associate Director for Development, Thomas L. Brown, Associate Director for Utilization Studies, Quinton E. Baker, Associate Director for Administration.

UNIFIED SCIENCES AND MATHEMATICS FOR ELEMENTARY SCHOOLS:
Mathematics and the Natural, Social, and Communications Sciences in Real Problem Solving.

School Supplies

Second Edition



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Trial Edition

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CHALLENGE: FIND EFFECTIVE WAYS TO MANAGE AND/OR CONSERVE SCHOOL SUPPLIES.

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Preface

The USMES Project

Unified Sciences and Mathematics for Elementary Schools: Mathematics and the Natural, Social, and Communications Sciences in Real Problem Solving (USMES) was formed in response to the recommendations of the 1967 Cambridge Conference on the Correlation of Science and Mathematics in the Schools.* Since its inception in 1970, USMES has been funded by the National Science Foundation to develop and carry out field trials of interdisciplinary units centered on long-range investigations of real and practical problems (or "challenges") taken from the local school/community environment. School planners can use these units to design a flexible curriculum for grades kindergarten through eight in which real problem solving plays an important role.

Development and field trials were carried out by teachers and students in the classroom with the assistance of university specialists at workshops and at occasional other meetings. The work was coordinated by a staff at the Education Development Center in Newton, Massachusetts. In addition, the staff at EDC coordinated implementation programs involving schools, districts, and colleges that are carrying out local USMES implementation programs for teachers and schools in their area.

Trial editions of the following units are currently available:

- Advertising
- Bicycle Transportation
- Classroom Design
- Classroom Management
- Consumer Research
- Describing People
- Designing for Human Proportions
- Design Lab Design
- Eating in School
- Getting There
- Growing Plants
- Manufacturing
- Mass Communications
- Nature Trails
- Orientation
- Pedestrian Crossings
- Play Area Design and Use
- Protecting Property
- School Rules
- School Supplies
- School Zoo
- Soft Drink Design
- Traffic Flow
- Using Free Time
- Ways to Learn/Teach
- Weather Predictions

*See *Goals for the Correlation of Elementary Science and Mathematics*, Houghton Mifflin Co., Boston, 1969.

USMES Resources

In responding to a long-range challenge, the students and teachers often have need of a wide range of resources. In fact, all of the people and materials in the school and community are important resources for USMES activities. In addition USMES provides resources for both teachers and students. A complete set of all the written materials comprise the USMES library, which should be available in each school using USMES units. These materials include--

1. *The USMES Guide*: This book is a compilation of materials that may be used for long-range planning of a curriculum that incorporates the USMES program. It describes the USMES project, real problem solving, classroom strategies, the Design Lab, the units, and the support materials as well as ways that USMES helps students learn basic skills.

2. *Teacher Resource Books* (one for each challenge): Each of these guides to using USMES units describes a broad problem, explains how students might narrow that problem to fit their particular needs, recommends classroom strategies, presents edited logs from teachers whose classes have worked on the unit, and contains charts that indicate basic skills, processes, and areas of study that students may learn and utilize.

3. *Design Lab Manual*: This guide helps teachers and administrators set up, run, and use a Design Lab--a place with tools and materials in which the students can build things they need for their work on USMES. A Design Lab may be a corner of a classroom, a portable cart, or a separate room. Because many "hands-on" activities may take place in the classroom, every USMES teacher should have a Design Lab Manual.

4. *"How To" Series*: These student materials provide information to students about specific problems that may arise during USMES units. The regular *"How To" Series* covers problems in measuring, graphing, data handling, etc., and is available in two versions--a series of

cartoon-style booklets for primary grades and a series of magazine-style booklets with more reading matter for upper grades. The *Design Lab "How To" Series* is available in two illustrated card versions--one for primary grades and one for upper grades. A complete list of the *"How To" Series* can be found in the *USMES Guide*.

5. *Background Papers*: These papers, correlated with the *"How To" Series*, provide teachers with information and hints that do not appear in the student materials. A complete list can be found in the *USMES Guide*.

6. *Curriculum Correlation Guide*: By correlating the twenty-six USMES units with other curriculum materials, this book helps teachers to integrate USMES with other school activities and lessons.

The preceding materials are described in brief in the USMES brochure, which can be used by teachers and administrators to disseminate information about the program to the local community. A variety of other dissemination and implementation materials are also available for individuals and groups involved in local implementation programs. They include *Preparing People for USMES: An Implementation Resource Book*, the USMES slide/tape show, the Design Lab slide/tape show, the Design Lab brochure, videotapes of classroom activities, a general report on evaluation results, a map showing the locations of schools conducting local implementation of USMES, a list of experienced USMES teachers and university consultants, and newspaper and magazine articles.

* * * * *

Because Tri-Wall was the only readily available brand of three-layered cardboard at the time the project began, USMES has used it at workshops and in schools; consequently, references to Tri-Wall can be found throughout the Teacher Resource Books. The addresses of suppliers of three-layered cardboard can be found in the Design Lab Manual.

Introduction

Using the Teacher Resource Book

When teachers try a new curriculum for the first time, they need to understand the philosophy behind the curriculum. The USMES approach to student-initiated investigations of real problems is outlined in section A of this Teacher Resource Book.

Section B starts with a brief overview of possible student activities arising from the challenge; comments on prerequisite skills are included. Following that is a discussion of the classroom strategy for USMES real problem-solving activities, including introduction of the challenge, student activity, resources, and Design Lab use. Subsequent pages include a description of the use of the unit in primary grades, a flow chart and a composite log that indicate the range of possible student work, and a list of questions that the teacher may find useful for focusing the students' activities on the challenge.

Because students initiate all the activities in response to the challenge and because the work of one class may differ from that undertaken by other classes, teachers familiar with USMES need to read only sections A and B before introducing the challenge to students.

Section C of this book is the documentation section. These edited teachers' logs show the variety of ways in which students in different classes have worked at finding a solution to the challenge.

Section D contains a list of the titles of relevant sets of "How To" Cards and brief descriptions of the Background Papers pertaining to the unit. Also included in section D is a glossary of the terms used in the Teacher Resource Book and an annotated bibliography.

Section E contains charts that indicate the comparative strengths of the unit in terms of real problem solving, mathematics, science, social science, and language arts. It also contains a list of explicit examples of real problem solving and other subject area skills, processes, and areas of study learned and utilized in the unit. These charts and lists are based on documentation of activities that have taken place in USMES classes. Knowing ahead of time which basic skills and processes are likely to be utilized, teachers can postpone teaching that part of their regular program until later in the year. At that time students can study them in the usual way if they have not already learned them as part of their USMES activities.

A. Real Problem Solving and USMES

> *If life were of such a constant nature that there were only a few chores to do and they were done over and over in exactly the same way, the case for knowing how to solve problems would not be so compelling. All one would have to do would be to learn how to do the few jobs at the outset. From then on he could rely on memory and habit. Fortunately--or unfortunately depending upon one's point of view--life is not simple and unchanging. Rather it is changing so rapidly that about all we can predict is that things will be different in the future. In such a world the ability to adjust and to solve one's problems is of paramount importance.**

Real Problem Solving

USMES is based on the beliefs that real problem solving is an important skill to be learned and that many math, science, social science, and language arts skills may be learned more quickly and easily within the context of student investigations of real problems. Real problem solving, as exemplified by USMES, implies a style of education which involves students in investigating and solving real problems. It provides the bridge between the abstractions of the school curriculum and the world of the student. Each USMES unit presents a problem in the form of a challenge that is interesting to children because it is both real and practical. The problem is real in several respects: (1) the problem applies to some aspect of student life in the school or community, (2) a solution is needed and not presently known, at least for the particular case in question, (3) the students must consider the entire situation with all the accompanying variables and complexities, and (4) the problem is such that the work done by the students can lead to some improvement in the situation. This expectation of useful accomplishment provides the motivation for children to carry out the comprehensive investigations needed to find some solution to the challenge.

The level at which the children approach the problems, the investigations that they carry out, and the solutions

*Kenneth B. Henderson and Robert E. Pingry, "Problem-Solving in Mathematics," in *The Learning of Mathematics: Its Theory and Practice*. Twenty-first Yearbook of the National Council of Teachers of Mathematics (Washington, D.C.: The Council, 1953), p. 233.

The USMES Approach

that they devise may vary according to the age and ability of the children. However, real problem solving involves them, at some level, in all aspects of the problem-solving process: definition of the problem; determination of the important factors in the problem; observation; measurement; collection of data; analysis of the data using graphs, charts, statistics, or whatever means the students can find; discussion; formulation and trial of suggested solutions; clarification of values; decision making; and communications of findings to others. In addition, students become more inquisitive, more cooperative in working with others, more critical in their thinking, more self-reliant, and more interested in helping to improve social conditions.

To learn the process of real problem solving, the students must encounter, formulate, and find some solution to complete and realistic problems. The students themselves, not the teacher, must analyze the problem, choose the variables that should be investigated, search out the facts, and judge the correctness of their hypotheses and conclusions. In real problem-solving activities, the teacher acts as a coordinator and collaborator, not an authoritative answer-giver.

The problem is first reworded by students in specific terms that apply to their school or community, and the various aspects of the problem are discussed by the class. The students then suggest approaches to the problem and set priorities for the investigations they plan to carry out. A typical USMES class consists of several groups working on different aspects of the problem. As the groups report periodically to the class on their progress, new directions are identified and new task forces are formed as needed. Thus, work on an USMES challenge provides students with a "discovery-learning" or "action-oriented" experience.

Real problem solving does not rely solely on the discovery-learning concept. In the real world people have access to certain facts and techniques when they recognize the need for them. The same should be true in the classroom. When the students find that certain facts and skills are necessary for continuing their investigation, they learn willingly and quickly in a more directed way to acquire these facts and skills. Consequently, the students should have available different resources that they may use as they recognize the need for them, but they should still be left with a wide scope to explore their own ideas and methods.

Certain information on specific skills is provided by the sets of USMES "How To" Cards. The students are referred only to the set for which they have clearly identified a need and only when they are unable to proceed on their own. Each "How To" Cards title clearly indicates the skill involved--"How to Use a Stopwatch," "How to Make a Bar Graph Picture of Your Data," etc. (A complete list of the "How To" Cards can be found in Chapter IX of the USMES Guide.)

Another resource provided by USMES is the Design Lab or its classroom equivalent. The Design Lab provides a central location for tools and materials where devices may be constructed and tested without appreciably disrupting other classroom activities. Ideally, it is a separate room with space for all necessary supplies and equipment and work space for the children. However, it may be as small as a corner of the classroom and may contain only a few tools and supplies. Since the benefits of real problem solving can be obtained by the students only if they have a means to follow up their ideas, the availability of a Design Lab can be a very important asset.

Optimally, the operation of the school's Design Lab should be such as to make it available to the students whenever they need it. It should be as free as possible from set scheduling or programming. The students use the Design Lab to try out their own ideas and/or to design, construct, test, and improve many devices initiated by their responses to the USMES challenges. While this optimum operation of the Design Lab may not always be possible due to various limitations, "hands-on" activities may take place in the classroom even though a Design Lab may not be available. (A detailed discussion of the Design Lab can be found in Chapter VI of the USMES Guide, while a complete list of "How To" Cards covering such Design Lab skills as sawing, gluing, nailing, soldering, is contained in Chapter IX.)

Work on all USMES challenges is not only sufficiently complex to require the collaboration of the whole class but also diverse enough to enable each student to contribute according to his/her interest and ability. However, it should be noted that if fewer than ten to twelve students from the class are carrying out the investigation of a unit challenge, the extent of their discovery and learning can be expected to be less than if more members of the class are involved. While it is possible for a class to work on two related units at the same time, in many classes the students progress better with just one.

The amount of time spent each week working on an USMES challenge is crucial to a successful resolution of the

problem. Each challenge is designed so that the various investigations will take from thirty to forty-five hours, depending on the age of the children, before some solution to the problem is found and some action is taken on the results of the investigations. Unless sessions are held at least two or three times a week, it is difficult for the children to maintain their interest and momentum and to become involved intensively with the challenge. The length of each session depends upon the age level of the children and the nature of the challenge. For example, children in the primary grades may proceed better by working on the challenge more frequently for shorter periods of time, perhaps fifteen to twenty minutes, while older children may proceed better by working less frequently for much longer periods of time.

Student interest and the overall accomplishments of the class in finding and implementing solutions to the challenge indicate when the class's general participation in unit activities should end. (Premature discontinuance of work on a specific challenge is often due more to waning interest on the part of the teacher than to that of the students.) However, some students may continue work on a voluntary basis on one problem, while the others begin to identify possible approaches to another USMES challenge.

Importance of the Challenge

Although individual (or group) discovery and student initiation of investigations is the process in USMES units, this does not imply the constant encouragement of random activity. Random activity has an important place in children's learning, and opportunities for it should be made available at various times. During USMES activities, however, it is believed that children learn to solve real problems only when their efforts are focused on finding some solution to the real and practical problem presented in the USMES challenge. It has been found that students are motivated to overcome many difficulties and frustrations in their efforts to achieve the goal of effecting some change or at least of providing some useful information to others. Because the children's commitment to finding a solution to the challenge is one of the keys to successful USMES work, it is extremely important that the challenge be introduced so that it is accepted by the class as an important problem to which they are willing to devote a considerable amount of time.

The challenge not only motivates the children by stating the problem but also provides them with a criterion for judging their results. This criterion--if it works, it's right (or if it helps us find an answer to our problem, it's

a good thing to do)--gives the children's ideas and results a meaning within the context of their goal. Many teachers have found this concept to be a valuable strategy that not only allows the teacher to respond positively to all of the children's ideas but also helps the children themselves to judge the value of their efforts.

Role of the Teacher

With all of the above in mind, it can be said that the teacher's responsibility in the USMES strategy for open classroom activities is as follows:

1. Introduce the challenge in a meaningful way that not only allows the children to relate it to their particular situation but also opens up various avenues of approach.

2. Act as a coordinator and collaborator. Assist, not direct, individuals or groups of students as they investigate different aspects of the problem.

3. Hold USMES sessions at least two or three times a week so that the children have a chance to become involved in the challenge and carry out comprehensive investigations.

4. Provide the tools and supplies necessary for initial hands-on work in the classroom or make arrangements for the children to work in the Design Lab.

5. Be patient in letting the children make their own mistakes and find their own way. Offer assistance or point out sources of help for specific information (such as the "How To" Cards) only when the children become frustrated in their approach to the problem. Conduct skill sessions as necessary.

6. Provide frequent opportunities for group reports and student exchanges of ideas in class discussions. In most cases, students will, by their own critical examination of the procedures they have used, improve or set new directions in their investigations.

7. If necessary, ask appropriate questions to stimulate the students' thinking so that they will make more extensive and comprehensive investigations or analyses of their data.

8. Make sure that a sufficient number of students (usually ten to twelve) are working on the challenge so that activities do not become fragmented or stall.

Student success in USMES unit activities is indicated by the progress they make in finding some solution to the challenge, not by following a particular line of investigation nor by obtaining specified results. The teacher's role in the USMES strategy is to provide a classroom atmosphere in which all students can, in their own way, search out some solution to the challenge.

USMES in the Total School Program

Today many leading educators feel that real problem solving (under different names) is an important skill to be learned. In this mode of learning particular emphasis is placed on developing skills to deal with real problems rather than the skills needed to obtain "correct" answers to contrived problems. Because of this and because of the interdisciplinary nature of both the problems and the resultant investigations, USMES is ideal for use as an important part of the elementary school program. Much of the time normally spent in the class on the traditional approaches to math, science, social science, and language arts skills can be safely assigned to USMES activities. In fact, as much as one-fourth to one-third of the total school program might be allotted to work on USMES challenges. Teachers who have worked with USMES for several years have each succeeding year successfully assigned to USMES activities the learning of a greater number of traditional skills. In addition, reports have indicated that students retain for a long time the skills and concepts learned and practiced during USMES activities. Therefore, the time normally spent in reinforcing required skills can be greatly reduced if these skills are learned and practiced in the context of real problem solving.

Because real problem-solving activities cannot possibly cover all the skills and concepts in the major subject areas, other curricula as well as other learning modes (such as "lecture method," "individual study topics," or programmed instruction) need to be used in conjunction with USMES in an optimal education program. However, the other

instruction will be enhanced by the skills, motivation, and understanding provided by real problem solving, and, in some cases, work on an USMES challenge provides the context within which the skills and concepts of the major subject areas find application.

In order for real problem solving taught by USMES to have an optimal value in the school program, class time should be apportioned with reason and forethought, and the sequence of challenges investigated by students during their years in elementary school should involve them in a variety of skills and processes. Because all activities are initiated by students in response to the challenge, it is impossible to state unequivocally which activities will take place. However, it is possible to use the documentation of activities that have taken place in USMES trial classes to schedule instruction on the specific skills and processes required by the school system. Teachers can postpone the traditional way of teaching the skills that might come up in work on an USMES challenge until later in the year. At that time students can learn the required skills in the usual way if they have not already learned them during their USMES activities.

These basic skills, processes, and areas of study are listed in charts and lists contained in each Teacher Resource Book. A teacher can use these charts to decide on an overall allocation of class time between USMES and traditional learning in the major subject disciplines. Examples of individual skills and processes are also given so that the teacher can see beforehand which skills a student may encounter during the course of his investigations. These charts and lists may be found in section E.

Ways In Which USMES Differs From Other Curricula

As the foregoing indicates, USMES differs significantly from other curricula. Real problem solving develops the problem-solving ability of students and does it in a way (learning-by-doing) that leads to a full understanding of the process. Because of the following differences, some teacher preparation is necessary. Some teachers may have been introduced by other projects to several of the following new developments in education, but few teachers have integrated all of them into the new style of teaching and learning that real problem solving involves.

1. New Area of Learning--Real problem solving is a new area of learning, not just a new approach or a new content within an already-defined subject area. Although many subject-matter curricula

include something called problem solving, much of this problem solving involves contrived problems or fragments of a whole situation and does not require the cognitive skills needed for the investigation of real and practical problems. Learning the cognitive strategy required for real problem solving is different from other kinds of learning.

3. Interdisciplinary Education--Real problem solving integrates the disciplines in a natural way; there is no need to impose a multi-disciplinary structure. Solving real and practical problems requires the application of skills, concepts, and processes from many disciplines. The number and range of disciplines are unrestricted and the importance of each is demonstrated in working toward the solution of practical problems.

3. Student Planning--To learn the process of problem solving, the students themselves, not the teacher, must analyze the problem, choose the variables that should be investigated, search out the facts, and judge the correctness of the hypotheses and conclusions. In real problem-solving activities the teacher acts as a coordinator and collaborator, not as an authoritative source of answers.

4. Learning-by-Doing--Learning-by-doing, or discovery learning as it is sometimes called, comes about naturally in real problem solving since the problems tackled by each class have unique aspects; for example, different lunchrooms or pedestrian crossings have different problems associated with them and, consequently, unique solutions. The challenge, as defined in each situation, provides the focus for the children's hands-on learning experiences, such as collecting real data; constructing measuring instruments, scale models, test equipment, etc.; trying their suggested improvements; and (in some units) preparing reports and presentations of their findings for the proper authorities.

5. Learning Skills and Concepts as Needed--Skills and concepts are learned in real problem solving

as the need for them arises in the context of the work being done, rather than having a situation imposed by the teacher or the textbook being used. Teachers may direct this learning when the need for it arises, or students may search out information themselves from resources provided.

6. Group Work--Progress toward a solution to a real problem usually requires the efforts of groups of students, not just individual students working alone. Although some work may be done individually, the total group effort provides good opportunities for division of labor and exchange of ideas among the groups and individuals. The grouping is flexible and changes in order to meet the needs of the different stages of investigation.

7. Student Choice--Real problem solving offers classes the opportunity to work on problems that are real to them, not just to the adults who prepare the curriculum. In addition, students may choose to investigate particular aspects of the problem according to their interest. The variety of activities ensuing from the challenge allows each student to make some contribution towards the solution of the problem according to his or her ability and to learn specific skills at a time when he or she is ready for that particular intellectual structure.

B. General Papers on School Supplies

1. OVERVIEW OF ACTIVITIES

Challenge:

Find effective ways to manage and/or conserve school supplies.

Possible Class Challenges:

Find good ways to manage school supplies for our class and for other students.

Establish and maintain a school store to sell supplies to students.

How can we collect discarded items and make them available for use by students and teachers in other classes?

Although most schools have an established system for distributing classroom supplies, situations may arise in which students find that the quantities are insufficient or that they need other materials not provided by the school for art or science class or for a special project. This lack of needed supplies may lead to the direct introduction of the School Supplies challenge. The challenge may also arise during the study of a specific topic, such as a science unit on ecology or a social science unit on conservation. In still other classes, another USMES unit, such as Manufacturing or Growing Plants, may lead to the School Supplies challenge as a result of the children's selling their manufactured product or their plants.

In some classes students may establish and maintain a school recycling center to provide discarded items for reuse by students and teachers. They usually conduct surveys to assess the demand for particular items and then tally and graph responses on bar graphs or histograms. Requested items may range from baby food jars, egg cartons, and old T-shirts to carpet and lumber scraps, cardboard, and used computer paper. While many items can be brought from home, others often require the students to use both imagination and hard work to find a good source.

After analyzing the information on requested items, students often form groups to work on various aspects of setting up their recycling center. One group may concentrate on locating specific supplies and thus spend time devising and making announcements to the student body and writing and telephoning local businesses and industries. Another group may be in charge of setting up a suitable location for the recycling center, perhaps a corner of the classroom or an unused closet or extra room. They may construct or decorate storage containers or they may decide to build additional shelves or a display case.

As the materials begin to accumulate, the students sort and categorize them. They may measure particular items, such as jars or boxes, to describe them more accurately, and they will often devise an inventory sheet to maintain a current record of supplies. The children must also decide how to distribute their collected items, for example, free use to teachers or to everyone, limited quantities per class or per person, or an exchange system where items are swapped for new contributions.

A publicity campaign often announces the opening of the

recycling center. Students set up a schedule of hours and workers, and they may devise simple order forms for their customers. After initial opening problems are resolved, the class then needs to meet only periodically to discuss any new problems and any suggested improvements. Should some items become overstocked, the students might hold a brainstorming session on possible uses and then pass their ideas on to other students.

Toward the end of the school year the class discusses what should be done with their remaining inventory, for example, holding a "grand give-away," sponsoring a contest for the most inventive use of discarded items, or saving special items for the next school year. Students may make a final evaluation of their recycling center by analyzing how many supply needs they were able to fill during the operation of their center.

When students establish a school store to sell supplies, they participate in many similar activities, such as surveying to determine popular items, finding a suitable location for the store, sorting materials, devising order forms, keeping an inventory, scheduling student workers and business hours, and advertising. In addition, the class handles many financial operations, including comparative shopping, calculating sales price and profit, bookkeeping, making change, holding a sale day at the end of the school year, and deciding how to use store profits.

Students who feel that existing school supplies are being misused may work with school authorities to assess the supply needs of the classes and to explore methods for more efficient use of available materials, for example, using a lower quality paper for practice work or cutting paper in half for short assignments such as spelling tests. Besides informing other classes of their suggestions for better management of supplies, students may also devise and maintain inventory records on the quantities and types of materials distributed to each class or each grade level. Based on their findings, the students may make recommendations to school authorities for decreasing waste and for lowering costs by improving the methods of selecting and distributing school supplies.

Although many of these research activities may require skills and concepts new to the children, there is no need for preliminary work on these skills and concepts because the children can learn them when the need arises. In fact, children learn more quickly and easily when they see a need to learn. Consider counting: whereas children usually learn to count by rote, they can, through USMES, gain a

supplies may provide the teacher with an ideal opportunity to ask the children what they think can be done to solve the problems they have identified.

One class of fifth-grade students became involved in the School Supplies challenge when they encountered a shortage of materials needed to conduct science experiments. While considering possible ways to remedy the situation, several students suggested bringing needed eye droppers and bottles from home. This led to a discussion of other discarded items that would be useful at school and then to the introduction of the challenge--"Find ways to collect and distribute discarded items for use by students and teachers." The class collected reusable materials, such as magazines, old T-shirts, crayons, bottles, and plastic containers, and distributed them to the school through their "Room 5 Supply House."

A combined class of fifth- and sixth-graders noted that all their crayons were too short to use. When they tried to obtain additional supplies from the office, they were told that all classroom supplies had been issued in September and that no more were available. One student then proposed that the class set up a classroom store to sell needed supplies. During a class discussion of the suggestion, the other children readily accepted the idea and decided that students in other classes might also find the services of a school supplies store useful. After conducting a survey to determine the demand for the store and the types of items needed, the class secured administration approval, purchased a basic inventory, designed and constructed a sales booth, and opened "The School Supply Shop" for business.

A School Supplies challenge may arise from the children's work on another USMES unit. For example, a class working on a Using Free Time challenge may find that additional supplies are needed for making games or for setting up an arts and crafts center. They may decide to collect discarded items for a particular use and then expand their operations

better understanding of counting by learning or practicing it within real contexts. In working on a School Supplies challenge, children also learn and practice graphing, measuring, working with decimals, and dividing. Although dividing seems necessary to compare fractions or ratios, primary children can make comparisons graphically; sets of data can also be compared graphically or by subtracting medians (half-way values). Furthermore, instead of using division to make scale drawings, younger children can convert their measurements to spaces on graph paper. Division may be introduced during calculation of percentages, averages, or unit costs.

2. CLASSROOM STRATEGY FOR SCHOOL SUPPLIES

Each USMES unit is centered on a challenge--a statement that says, "Solve this problem." The success or failure of the unit depends largely on (1) the relevance of the problem for the students and (2) the process by which they define and accept the challenge. If the children see the problem as a real one, they will be committed to finding a solution; they will have a focus and purpose for their activities. If the students do not think the problem affects them, their attempts at finding solutions will likely be disjointed and cursory.

The School Supplies challenge--"Find effective ways to manage and/or conserve school supplies"--is general enough to apply to many situations. Students in different classes define and reword the challenge to fit the particular problems of their school and thus arrive at a specific class challenge. For example, some classes have restated the challenge in terms of establishing a school store to sell supplies, while others have concentrated on setting up a distribution center for recycling discarded materials.

The Process of Introducing the Challenge

Given that a problem exists, how can a teacher, without being directive, help the students identify the challenge that they will work on as a group? There is no set method because of variations among teachers, classes, and schools and among the USMES units themselves. However, USMES teachers have found that certain general techniques in introducing the challenge are helpful.

One such technique is to turn a discussion of some recent event toward a related School Supplies challenge. For example, a discussion about a shortage of needed school

challenge is chosen.

Classroom experience has shown that children's progress on a School Supplies challenge may be poor if the teacher and students do not reach a common understanding of what the challenge is before beginning work on it. Having no shared focus for their work, the children will lack the motivation inherent in working together to solve a real problem. As a result, they may quickly lose interest.

A similar situation occurs if the teacher, rather than ensuring that the children have agreed upon a challenge, merely assigns a series of activities. Although the teacher may see how these activities relate to an overall goal, the children may not.

> *A teacher in one sixth-grade class issued a School Supplies challenge at the beginning of the school year when there was no shortage of regular supplies and no special need for particular items not provided by the school. Because the children saw no real problem, they made only half-hearted attempts to scrounge extra supplies. In trying to compensate for the students' lack of enthusiasm, the teacher became more directive, even telling the students to conduct surveys and keep an inventory of their items. The children became bored with the work, which had no meaning for them, and the unit was eventually discontinued.*

These problems can be avoided if the teacher issues the challenge at a time when the students have encountered a need for additional supplies or when a supplies problem surfaces naturally during a class discussion.

Initial Work on the Challenge

Once a class has decided to work on a School Supplies challenge, USMES sessions should be held several times a week, but they need not be rigidly scheduled. When sessions are held after long intervals, students often have difficulty remembering exactly where they were in their investigations and their momentum diminishes.

During the initial session, students often list school supplies that could be better managed or recycled or supplies that they could sell in their store. Sometimes a class will intermix the two lists. By combining similar types of materials and by focusing on only one aspect of

by organizing and maintaining a materials distribution center for the entire school. Similarly, a Manufacturing or Growing Plants challenge might develop into a school supplies store should the class decide to expand their sales of the manufactured item or plants.

When children working on another USMES challenge encounter a problem that leads to a School Supplies challenge, one group of children may begin work on this second challenge while another continues on the first. However, there should be at least ten or twelve students working on any one challenge; otherwise, the children's work may be fragmented or superficial or may break down completely.

The School Supplies challenge may also evolve during a discussion of a specific topic being studied by the class. For example, conservation of resources can be a natural lead-in to the recycling aspect of School Supplies and a discussion of how the students can participate in conserving resources.

After studying a social science topic on the conservation of their state's natural resources, an eighth-grade class began investigating ways they could help the conservation effort by better management of their school resources. The students scrounged discarded materials from home and from local industries, and they obtained permission to convert a large, unused closet into the housing for their "Hilsman Recycling Plant." The class also sponsored a school-wide book exchange as an additional activity directed towards reusing materials.

Sometimes the discussion of a broad problem may encompass the challenges of several related units. For example, a discussion of a current student concern, such as raising money for a class field trip, could lead to School Supplies, Manufacturing, Soft Drink Design, or Growing Plants, depending on the children's focus.

An experienced USMES teacher is usually willing to have the children work on any one of the several challenges that may arise during the discussion of a broad problem. While this approach gives the children the opportunity to select the challenge they are most interested in investigating, it does place on the teacher the additional responsibility of being prepared to act as a resource person for whichever

specific procedures, the teacher asks open-ended questions that stimulate the students to think more comprehensively and creatively about their work. For example, instead of telling the children that they should devise an inventory form to keep track of their supplies, the teacher might ask how they will know when to restock their supplies. Examples of other nondirective, thought-provoking questions are given at the end of this section.

Also, the teacher may refer students to those "How To" Cards relating to specific skills, such as graphing, when they are needed for their School Supplies activities. If many students, or even the entire class, need help in particular areas, such as taking a survey or finding averages, the teacher should conduct skill sessions. (Background Papers on topics relating to School Supplies activities may be helpful for teachers.)

USMES teachers can also assist students by making it possible for them to carry out tasks involving hands-on activities. If the children need to collect data outside their classroom--at local stores or in other classrooms--the teacher can help with scheduling and supervision. If the children's tasks require them to design and construct items, such as a collection bin or display case, the teacher should make sure that they have access to a Design Lab--any collection of tools and materials kept in a central location (in part of the classroom, on a portable cart, or in a separate room). A more detailed description of the Design Lab may be found in the USMES Guide.

Valuable as it is, a Design Lab is not necessary to begin work on School Supplies. The Design Lab is used only when needed, and, depending on the investigations chosen by the children, the need may not arise at all.

One class of fifth-graders worked successfully on the School Supplies challenge without the use of a Design Lab. The students initially secured permission to convert an unused room into an area for their recycling center; however, an increased enrollment at school made the room unavailable for their use. Consequently, the students set up the storage area for their supplies within their classroom. They scrounged extra free-standing lockers and a two-sided bookcase from the school and carefully labeled all the compartments and shelves according to the contents.

the School Supplies problem, the class can arrive at a manageable challenge. If the students try to tackle too many problems at once, their investigations will be superficial.

Next the children often suggest and categorize various tasks needed to complete their goals, and they set priorities for these activities, most of which are carried out by students working in small groups.

As various groups complete their work, their members join other groups or form new groups to work on additional tasks. However, if too many groups are formed, work on the challenge can become fragmented. The teacher finds it impossible to be aware of the progress and problems of each group; in addition, the small number of students in each group lessens the chance of varied input and interaction.

Refocusing on the Challenge

As a class works on a School Supplies challenge, the children's attention should, from time to time, be refocused on that challenge so that they do not lose sight of their overall goal. Teachers usually find it helpful to hold periodic class discussions that include group reports. Such sessions help the students review what they have accomplished and what they still need to do to find some solution to their supplies problem. These discussions also provide an opportunity for students to evaluate their own work and to exchange ideas with their classmates. Without these sessions, there is a strong possibility that the children's efforts will overlap unnecessarily.

> *In one class the thirty-seven students divided into eight groups to set up their school store. The teacher acted almost totally as an observer and neglected to ask the students what they were doing in their groups or even what they planned to do. Because the students had only a long-range goal to open a school store but no priorities for their intermediate tasks, there was much floundering. Students in some groups started working independently and there was little sharing of ideas.*

When children try to decide on solutions before collecting and analyzing enough data or when they encounter difficulties during their investigations, an USMES teacher helps out. Instead of giving answers or suggesting

An eighth-grade class converted an unused closet into the housing for their distribution center. The students completed all their work, including the construction of a table from scrap lumber, without the use of a Design Lab. Once their center started operation, the class also sponsored a school-wide book exchange with work on all advertising notices and other needed materials being completed in the classroom.

Culminating Activities

To carry out construction activities in schools without Design Labs, students may scrounge or borrow tools and supplies from parents, local businesses, or other members of the community. The extent to which any Design Lab is used varies with different classes because the children themselves determine the direction of the School Supplies investigations.

Student activities on a School Supplies challenge generally continue until the children feel that they have reached an adequate solution to their supplies problem. Often the unit will continue until the end of the school year, especially if the class is operating a school store or recycling center. Once either has been set up and is running smoothly, the students may find that their major tasks have been at least temporarily completed. They may choose to have rotating groups of volunteers take turns as managers who are responsible for ongoing activities, such as scheduling workers, publicity, inventory control, and bookkeeping. Periodic reports to the class provide a time for acting on decisions that need to be made by everyone. As particular problems arise, the class may become involved in related USMES challenges, for example, Consumer Research, Advertising, or Manufacturing.

3. USE OF SCHOOL SUPPLIES IN THE PRIMARY GRADES

Primary children may encounter a variety of problems with their supplies which can lead to the introduction of a School Supplies challenge. A letter from the principal asking classes to conserve materials or an actual lack of specific supplies may prompt primary children to scrounge recyclable items or to obtain and sell needed items to other students. The problem may be even more basic, as exemplified by the second-grade class whose greatest

supply problem was keeping track of the supplies the children already had.

Although more than one problem may be identified, primary children will usually make more progress if they are actively working on only one School Supplies challenge at a time. For example, the second graders who kept losing their supplies, investigated the best location for a classroom Lost-and-Found box. When their major tasks were completed and they were simply collecting data on the popularity of various box locations, the students then focused their attention on another supplies problem that had developed, a lack of math folders.

Often during work on the challenge, the students may decide to take a simple survey to determine whether the problem is real to other students or to ascertain preferences for particular supplies. The survey may be a simple checklist of needed supplies or a list of questions with yes/no answers. One group of second graders devised a preference survey with open-ended questions. Realizing that the students were likely to encounter difficulties with so many responses, the teacher asked how many answers might be received for each question. In discussing the inquiry, the children soon realized that a checklist of possible answers would make their tallying much easier.

Counting skills are learned and practiced as students tally survey votes or perhaps numbers of supplies in their inventory. The second-grade class began tallying their survey of suggested locations for a Lost-and-Found box by listing each location and underneath it, the names of the children suggesting it. The teacher led a discussion on tallying data, asking the children to consider the exact information they needed. After some debate, one child suggested substituting the names with lines (i.e., tally marks) which would indicate the number of votes for each location.

One class of first graders learned that taking an inventory was counting the number of each recycled item they had collected as "Beautiful Junk." The children listed the name of each item, e.g., egg carton, gallon milk jug, paper bags, and the quantity. Using a large supply of plastic chips, the teacher gave a skill session on estimation, and the children later checked their estimates by counting out the exact number of chips.

Learning how to count money and make change is an important skill practiced by primary classes who sell supplies to other students. Hands-on experience with money gives the children a good opportunity to put their addition and

subtraction skills to practical use. They may begin by categorizing like coins and then learn about equivalents, progressing from simple problems such as one dime equals two nickels equals ten pennies, to more complicated computations.

USMES teachers have found that even students with limited skills are able to make price calculations that are accurate enough for their purposes. For example, rather than using division to find the unit cost of 30 pencil erasers selling for $1.00, the children could separate 100 pennies into 30 piles and find that each eraser costs 3¢ plus. If the students are trying to compare the pieces of different sizes or weights of the same item, they can be taught how to construct slope diagrams.

Graphing is a simple activity for the children to learn, especially the "stack 'em" graph. For example, numbers of supplies or votes on a survey can be tallied by stacking an appropriate number of blocks, with a separate color representing each item. Later, the teacher can explain how to make bar graphs on paper by comparing the spaces on the graph paper with the blocks stacked by the children.

Working with various types, shapes, and sizes of containers often leads primary children to discussions of measurement. Just what does "dozen" mean on an egg carton? How many quart milk cartons will fill a gallon milk jug? These and other similar questions were explored by the first graders who took an inventory of their "Beautiful Junk." Students in the second-grade class used rulers to measure the exact size of the math folders they constructed.

Young children practice language arts skills when they report to the class on what they have done, make inventory sheets, and devise and administer surveys. Both communication skills and artistic talent are practiced as the children conduct publicity campaigns with their notes, posters, and announcements promoting the use or purchase of their supplies.

4. FLOW CHART

The following flow chart presents some of the student activities--discussions, observations, calculations, constructions--that may occur during work on a School Supplies challenge. Because each class will choose its own approach to the challenge, the sequences of events given here represent only a few of the many possible variations. Further-

more, no one class is expected to undertake all the activities listed.

The flow chart is not a lesson plan and should not be used as one. Instead, it illustrates how comprehensive investigations evolve from the students' discussion of a Schcol Supplies problem.

Challenge: Find effective ways to marage and/or conserve school supplies.

Optional Preliminary Activities:

USMES Units:
- *Manufacturing*
- *Growing Plants*
- *Consumer Research*
- *Classroom Management*
- *Soft Drink Design*
- *Design Lab Design*
- *Using Free Time*

Science topic on recycling, conservation

Possible Student Activities:

Class Discussion: What can we do about securing needed supplies or finding an outlet for our products? What supplies are needed: Who might be interested in using these supplies? How can we prove there is a shortage of supplies or a need for better management of supplies?

Data Collection: Devising, carrying out school survey to determine types and quantities of supplies needed by other students and teachers.

Data Collection: Working with school authorities, e.g., principal, to determine types and quantities of supplies provided by school.

Data Representation: Tallying data. Making bar graphs, line charts, histograms.

Class Discussion: Discussion and analysis of collected data. Identification of desired changes in distribution, management, or source of school supplies. Deciding on priorities for change and working on a particular aspect, e.g., school store to sell supplies, distribution center providing discarded items for reuse, or working with school authorities to determine better methods of managing supplies provided by school.

School Store. (See Flow Chart A.)

Distribution center for recycled supplies. (See Flow Chart B.)

Working with school authorities on management of existing supplies. (See Flow Chart C.)

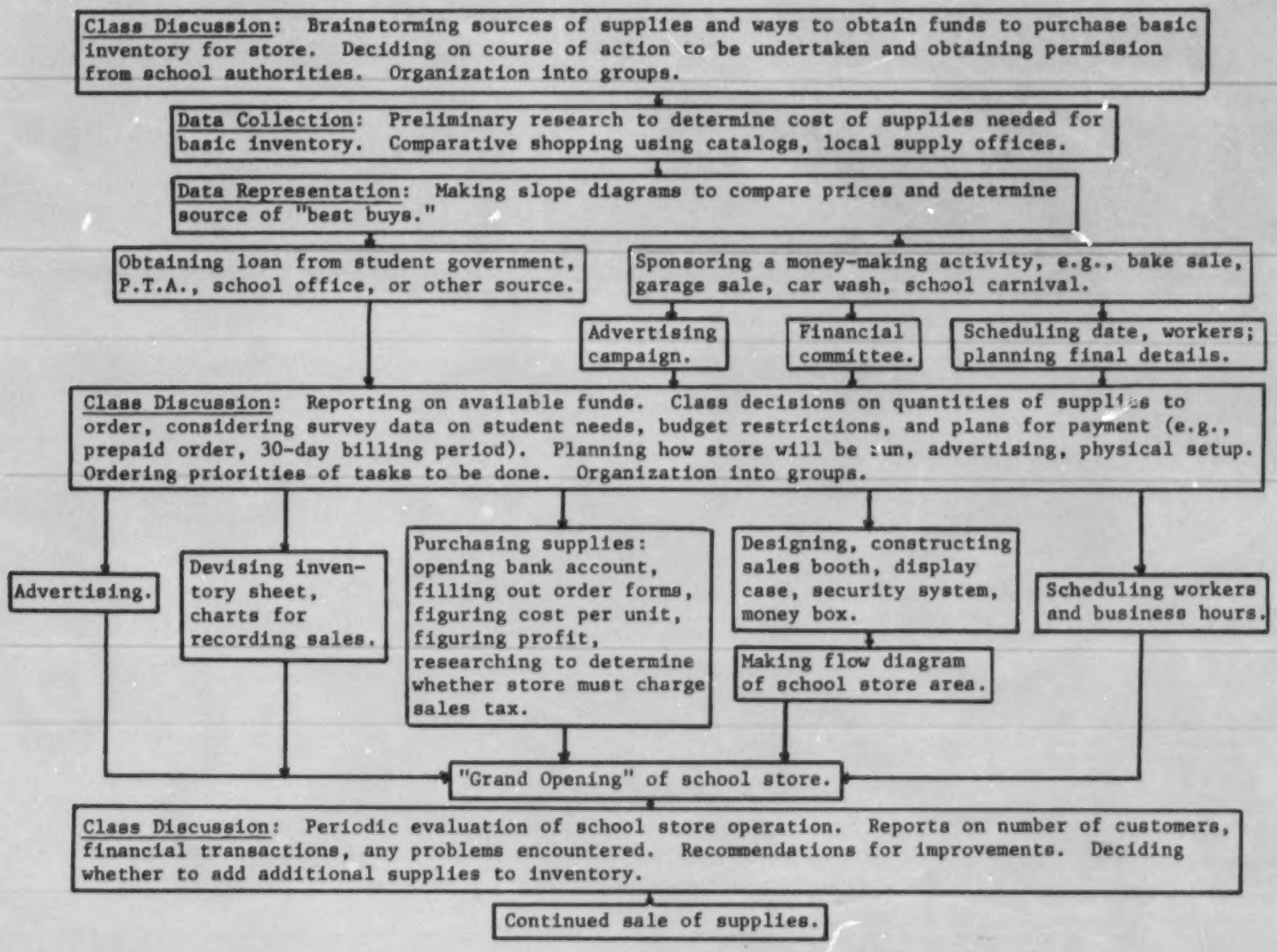
Class Discussion: Final evaluation of class efforts at managing and/or conserving school supplies.

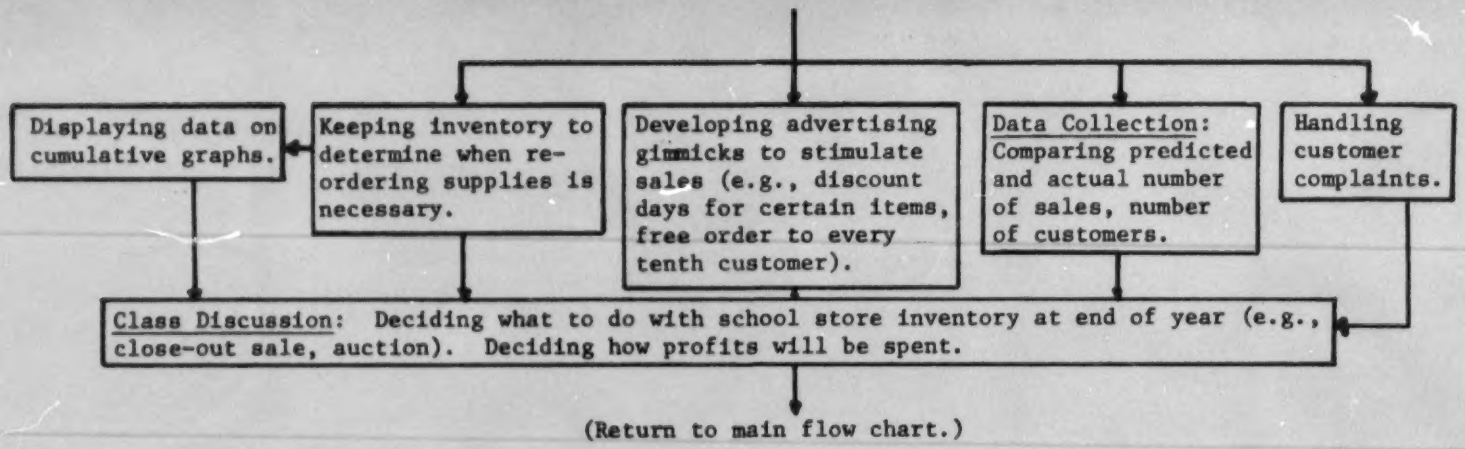
Optional Follow-Up Activities:

USMES Units:
- *Advertising*
- *Consumer Research*
- *Manufacturing*
- *Designing for Human Proportions*
- *Classroom Management*
- *Using Free Time*

FLOW CHART A

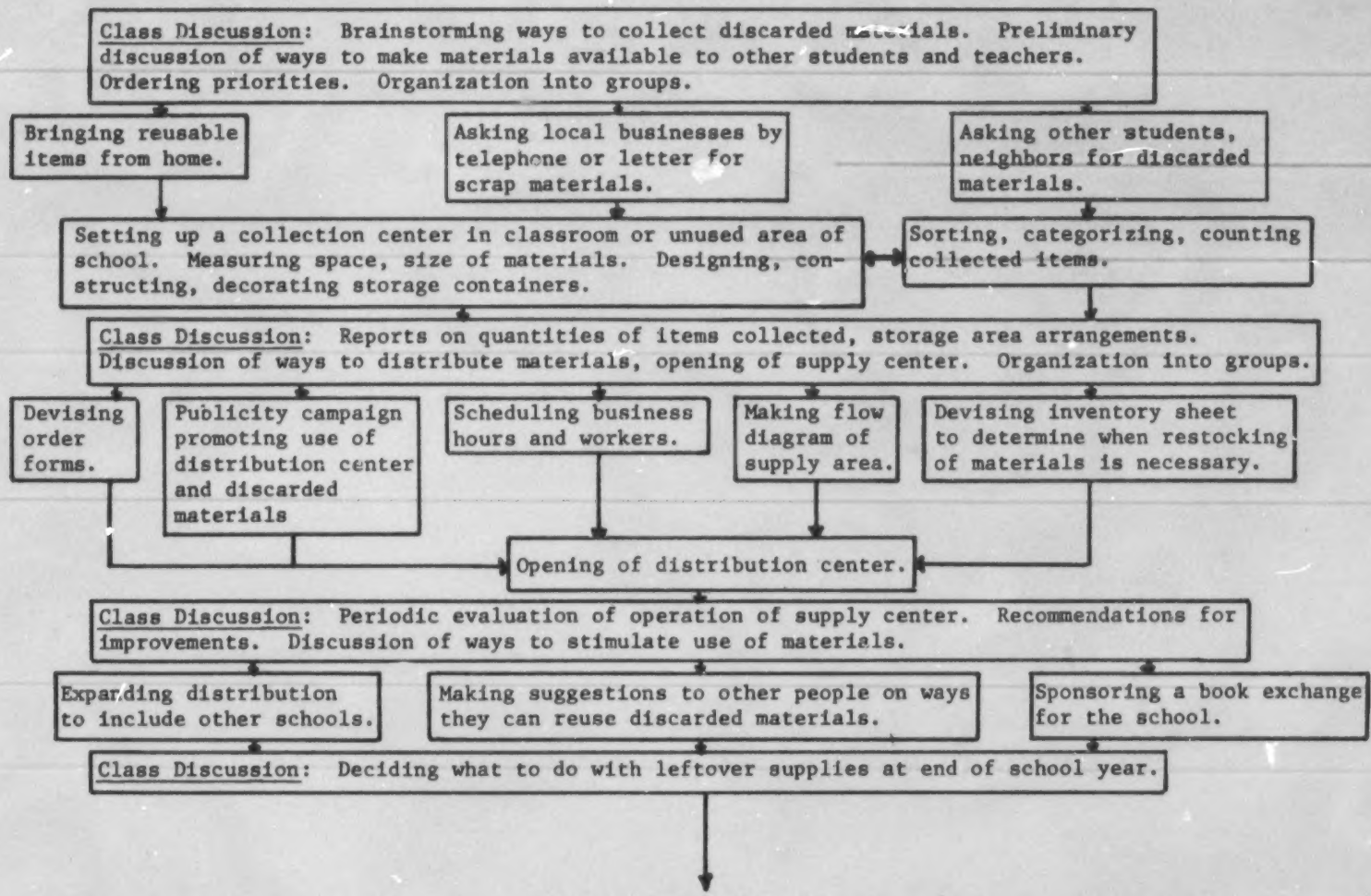
School Store


Class Discussion: Brainstorming sources of supplies and ways to obtain funds to purchase basic inventory for store. Deciding on course of action to be undertaken and obtaining permission from school authorities. Organization into groups.
Data Collection: Preliminary research to determine cost of supplies needed for basic inventory. Comparative shopping using catalogs, local supply offices.
Data Representation: Making slope diagrams to compare prices and determine source of "best buys."
Obtaining loan from student government, P.T.A., school office, or other source.
Sponsoring a money-making activity, e.g., bake sale, garage sale, car wash, school carnival.
Advertising campaign.
Financial committee.
Scheduling date, workers; planning final details.
Class Discussion: Reporting on available funds. Class decisions on quantities of supplies to order, considering survey data on student needs, budget restrictions, and plans for payment (e.g., prepaid order, 30-day billing period). Planning how store will be run, advertising, physical setup. Ordering priorities of tasks to be done. Organization into groups.
Advertising.
Devising inventory sheet, charts for recording sales.
Purchasing supplies: opening bank account, filling out order forms, figuring cost per unit, figuring profit, researching to determine whether store must charge sales tax.
Designing, constructing sales booth, display case, security system, money box.
Scheduling workers and business hours.
Making flow diagram of school store area.
"Grand Opening" of school store.
Class Discussion: Periodic evaluation of school store operation. Reports on number of customers, financial transactions, any problems encountered. Recommendations for improvements. Deciding whether to add additional supplies to inventory.
Continued sale of supplies.


Displaying data on cumulative graphs.
Keeping inventory to determine when re-ordering supplies is necessary.
Developing advertising gimmicks to stimulate sales (e.g., discount days for certain items, free order to every tenth customer).
Data Collection: Comparing predicted and actual number of sales, number of customers.
Handling customer complaints.
Class Discussion: Deciding what to do with school store inventory at end of year (e.g., close-out sale, auction). Deciding how profits will be spent.
(Return to main flow chart.)

FLOW CHART B

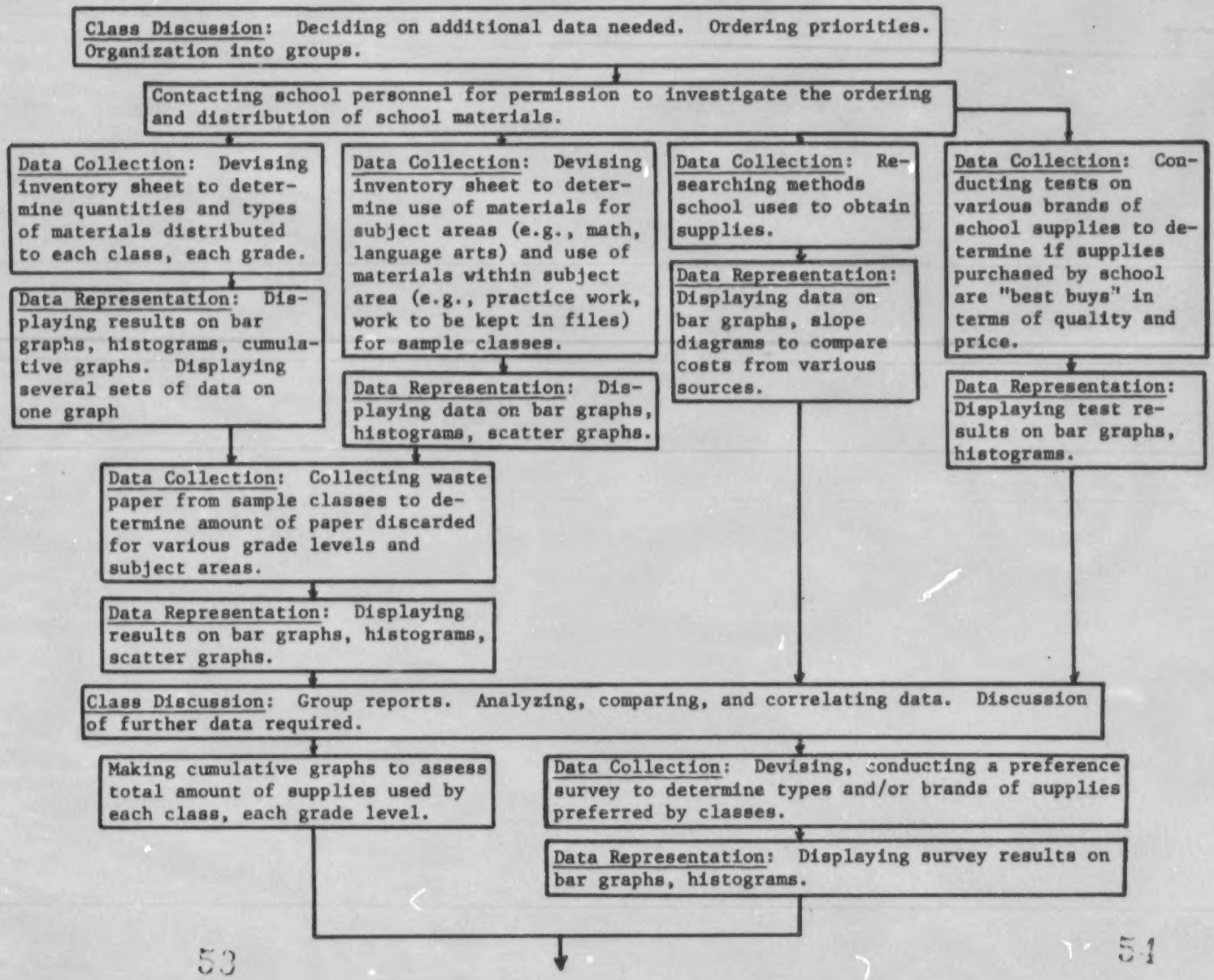
Distribution Center

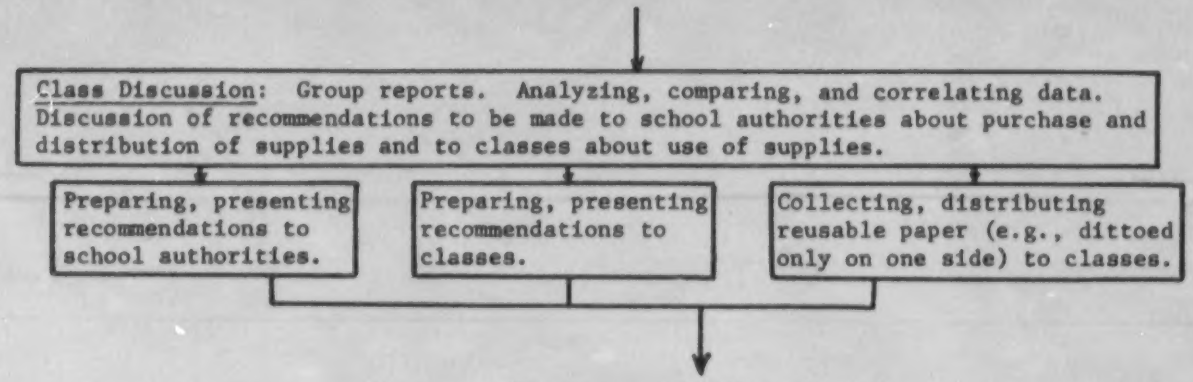

Class Discussion: Brainstorming ways to collect discarded materials. Preliminary discussion of ways to make materials available to other students and teachers. Ordering priorities. Organization into groups.
Bringing reusable items from home.
Asking local businesses by telephone or letter for scrap materials.
Asking other students, neighbors for discarded materials.
Setting up a collection center in classroom or unused area of school. Measuring space, size of materials. Designing, constructing, decorating storage containers.
Sorting, categorizing, counting collected items.
Class Discussion: Reports on quantities of items collected, storage area arrangements. Discussion of ways to distribute materials, opening of supply center. Organization into groups.
Devising order forms.
Publicity campaign promoting use of distribution center and discarded materials
Scheduling business hours and workers.
Making flow diagram of supply area.
Devising inventory sheet to determine when restocking of materials is necessary.
Opening of distribution center.
Class Discussion: Periodic evaluation of operation of supply center. Recommendations for improvements. Discussion of ways to stimulate use of materials.
Expanding distribution to include other schools.
Making suggestions to other people on ways they can reuse discarded materials.
Sponsoring a book exchange for the school.
Class Discussion: Deciding what to do with leftover supplies at end of school year.

(Return to main flow chart.)

FLOW CHART C

Management of School Supplies


Class Discussion: Deciding on additional data needed. Ordering priorities. Organization into groups.
Contacting school personnel for permission to investigate the ordering and distribution of school materials.
Data Collection: Devising inventory sheet to determine quantities and types of materials distributed to each class, each grade.
Data Representation: Displaying results on bar graphs, histograms, cumulative graphs. Displaying several sets of data on one graph
Data Collection: Devising inventory sheet to determine use of materials for subject areas (e.g., math, language arts) and use of materials within subject area (e.g., practice work, work to be kept in files) for sample classes.
Data Representation: Displaying data on bar graphs, histograms, scatter graphs.
Data Collection: Researching methods school uses to obtain supplies.
Data Representation: Displaying data on bar graphs, slope diagrams to compare costs from various sources.
Data Collection: Conducting tests on various brands of school supplies to determine if supplies purchased by school are "best buys" in terms of quality and price.
Data Representation: Displaying test results on bar graphs, histograms.
Data Collection: Collecting waste paper from sample classes to determine amount of paper discarded for various grade levels and subject areas.
Data Representation: Displaying results on bar graphs, histograms, scatter graphs.
Class Discussion: Group reports. Analyzing, comparing, and correlating data. Discussion of further data required.
Making cumulative graphs to assess total amount of supplies used by each class, each grade level.
Data Collection: Devising, conducting a preference survey to determine types and/or brands of supplies preferred by classes.
Data Representation: Displaying survey results on bar graphs, histograms.


Class Discussion: Group reports. Analyzing, comparing, and correlating data. Discussion of recommendations to be made to school authorities about purchase and distribution of supplies and to classes about use of supplies.
Preparing, presenting recommendations to school authorities.
Preparing, presenting recommendations to classes.
Collecting, distributing reusable paper (e.g., dittoed only on one side) to classes.

(Return to main flow chart.)

5. A COMPOSITE LOG*

This hypothetical account of an intermediate-level class describes many of the activities and discussions mentioned in the flow charts. This composite log shows only one of the many progressions of events that might develop as a class investigates the School Supplies challenge. Documented events from actual classes are italicized and set apart from the text.

At the beginning of the school year a combination fourth/fifth/sixth-grade class is involved in a discussion of the various things the children had particularly enjoyed about their summer vacation. Several of the girls mention that they had worked with their scout troop to start a recycling center for the community. They enlist the support of the students and their parents to help keep the center operating during the school year.

The class is soon debating the meaning of recycle. Several students feel that recycling doesn't necessarily mean that items are used again for their original purpose. One boy explains that old jars can be used for mixing paint in art class or for storing nails in the Design Lab; he feels that this, too, is recycling. His examples inspire other students to think of things that are normally discarded which could be reused at school, and a lively discussion is soon underway. The teacher finds this an ideal time to introduce the challenge, "Develop a recycling system to provide school materials for use by teachers and students."

An eighth-grade class in Athens, Georgia, became involved in the School Supplies challenge while they were studying a social science topic on the conservation of natural resources in their state. The students discussed various ways they could help the conservation effort, and they eventually focused on two major activities: (1) organizing and maintaining a school recycling plant to provide discarded items for reuse by teachers and students; (2) sponsoring a school-wide book exchange for trading books or buying donated books at a low price. (See log by Sherry Malone.)

In response to a discussion about what they could do to help supply school needs, a sixth-grade class in Ganado, Arizona, decided to work on two problems: (1) setting up and running a school store and (2) providing a playground equipment rental service for the school. (From log by Sara Keeney.)

*Written by USMES staff

The students are very excited over the prospect of setting up their own recycling center. Together they compile the following list of reusable items which they feel they could supply to students and teachers:

cardboard boxes
plastic milk jugs
yarn, string
partially used paper
popsicle sticks
scrap paper
telephone books
dish liquid containers
magazines, books
rubber bands
broken crayons
old candles
jars, bottles
old T-shirts
egg cartons
butter tubs
paper bags
newspapers
styrofoam trays
buttons
scrap fabric
pencils
tin cans
cardboard cylinders

A class of sixth graders in Boulder, Colorado, decided to expand their school store operation by including a recycling bin. The students agreed that because primary classes were more likely to have frequent uses for discarded items, eight "exchange" students would spend a day with first-grade classes and record the types of recyclable items they used. Reports were later given to the entire class and included an interview with one primary teacher on the types of materials she could use. (See log by John Limon.)

When an extensive list has been placed on the board, the teacher asks, "Suppose we start collecting these things, and we have 200 egg cartons, but nobody wants egg cartons. How can we find out before we collect a large quantity of egg cartons whether people will really want them?" The children realize that they ought to ask the teachers about the need for the items they have listed, and they decide to conduct a survey.

A fifth-grade class in Monterey, California, decided to scrounge old medicine droppers from home so that everyone would have the necessary equipment to conduct individual science experiments. The students also discussed other discarded items

that could be used at school, and they decided to set up a recycling center. To determine what materials to collect, the class devised and dittoed a survey letter which they distributed to all teachers at their school. (From log by William Kucher.)

As the students are discussing the survey format, one of the boys asks, "How will we know how many of something a teacher might want if there is just a check next to it?" Another student adds that the teachers might not know the exact quantity until they actually need something for class. After further discussion the students decide to list several ranges of numbers beside each item and ask the teachers to choose one range.

The children then work in three groups. One group continues refining the survey format. They decide that they don't want to store a large quantity of items that won't be used until a much later date, and so they include a January deadline. After several other minor revisions, they carefully copy the format shown in Figure B5-1 on a ditto master.

The other two groups prepare for the distribution of the survey. One group obtains a teacher list from the office, while the other drafts a letter to accompany the survey, explaining the recycling plans of the class.

Please check the number of each item that you think you can use between now and January. Write other items at the bottom.

Item	0	1-10	11-20	21-30	over 30
1. Old magazines					
2. Butter tubs					
3. Glass jars					
4. Egg cartons					

Others

Figure B5-1

One group from the Ganado class decided to survey the other classes in the school about their preferences for items to be sold. They listed eight items with approximate prices for each on a ditto master and ran off enough copies for the school. After practicing in their own class, they conducted their survey in the other classes. When the replies came back, they tallied the results and made bar graphs of their data. (From log by Sara Keeney.)

In February, when a combination fifth/sixth grade class in Lansing, Michigan, discovered that all supplies provided by the school had been distributed in September, they set up a school store to sell supplies to other students. To determine which supplies were most needed, the class decided

to conduct a survey asking students to check the items they would like the store to sell. After a trial run of the survey, the students realized that revisions were needed so that the results would provide more data on the items that customers not only liked but would actually purchase. The directions were rewirtten to ask students to mark in order of their preference the first three supplies they would pruchase with fifty cents. (From log by Elnora Martin.)

In Boulder, Colorado, a fifth-grade class decided that if their school store were to get the business they wanted, they would need to sell items that were both popular and acceptable to students, teachers, and parents. The students devised a separate survey format for each of the three groups:

1. *Students in each class listed suggestions and then voted for the top ten choices.*
2. *Teachers were asked to check appropriate items from a list of twenty-three possibilities provided on the survey.*
3. *Parents listed five items which they felt would be acceptable for their children to purchase. (See log by Margaret Hartzler and Kathleen Schultz.)*

The surveys are distributed and returned promptly by most of the teachers; a few teachers are personally reminded, and soon all the surveys are ready to be tallied. The students immediately discover that they cannot simply add a column of numbers to get a total estimate for each item because the answers are in ranges. Some students feel that the survey is useless, and there is much discussion about what to do with all the numbers. Finally, one of the girls solves the problem. She suggests that each item have two tallies, one for the lower numbers in the ranges checked and another for the higher numbers

The fifth-grade class in Boulder tallied each of the three surveys and displayed the results on separate bar graphs. When the students decided

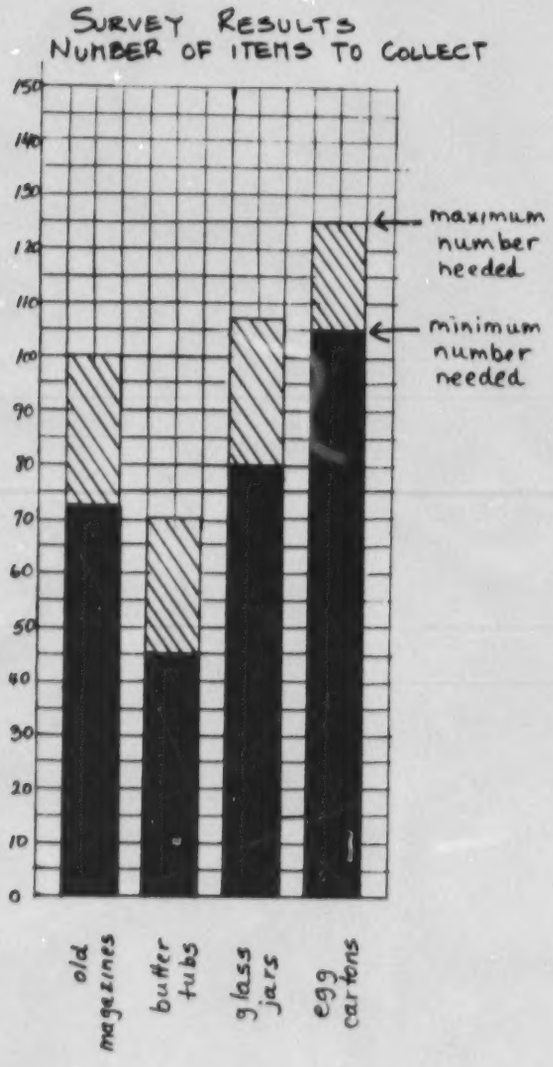


Figure B5-2

to compile all their survey data, they realized that one vote did not represent the same number of people on each survey; for example, in the class survey, one vote represented an entire class). To solve this problem, the students found the average class size (twenty-six students) and then converted the class survey votes into individual votes. The total tally was depicted on a bar graph and used by the students to decide on both the items and the quantities to order for the basic inventory of their school store. (See log by Margaret Hartzler and Kathleen Schultz.)

As the numbers are totaled on a master list, the children began eagerly trying to pick out the most requested items. When the teacher asks whether anyone knows of a simple way to make a picture of their data, several children immediately respond, "Make a graph." However, because many of the students are unfamiliar with graphing, the teacher conducts a brief skill session using the overhead projector and the set of "How To" Cards, "How to Make a Bar Graph Picture of Your Data."

The Lansing class tallied the survey votes from 115 students and displayed the results on a bar graph. From this data the students decided that their store inventory should definitely include folders, pencils, erasers, markers, notebooks, crayons, and a small quantity of pens. (From log by Elnora Martin.)

The class next discusses that their bar graphs will require a slight variation because each item has a range of numbers. One girl, who has had prior experience in graphing, suggests using one color for the bottom end of the range and then continuing the bar with another color. She gives a quick demonstration at the chalkboard, and the children then make bar graphs similar to the one shown in Figure B5-2.

With the graphs completed, the class begins to analyze the data. "By looking at our graphs, we'll know to collect how many butter tubs?" the teacher asks.

"At least 150," replies one of the boys, "and maybe 200."

"That's right," says the teacher. "We can look at the graphs and tell the least, or minimum, number we will probably need and also the most, or maximum, number."

"But what happens," interjects a student, "if we collect 150 tubs and then some teacher wants the maximum amount in the column he checked and not the minimum. Then, even if everybody else wants the minimum, we still won't have enough."

The other children realize the potential problem of undersupply if they collect only the minimum amount shown on the graphs. Another student adds that similarly, oversupply could be a problem if all the teachers should request only the minimum amount.

Various solutions are discussed, and finally the class agrees to collect the minimum amount "plus some, just to be safe." The children reason that they will be able to fill at least all minimum orders and also some additional ones. And they agree that if the supply of any one item begins to dwindle, they can then collect up to the maximum amount, or enough to fill potential orders.

Later the class lists the activities they will need to complete before opening their distribution center. They categorize the tasks into three major areas and decide to work in three groups accordingly:

(1) Collection Group: Find out where to get supplies and start collecting.

(2) Location Group: Decide where the distribution center will be located and get it set up.

(3) Distribution Group: Figure out best ways to distribute materials and to let everybody know about what's available.

The activities of the three groups are described in the following paragraphs.

Collection Group

Members of this group first hold a brainstorming session to think of as many sources of discarded items as they can. They readily agree that not only their classmates but also their schoolmates and other teachers and faculty members will probably bring many items. Some parents might be able to contribute materials from where they work, and one boy suggests looking for stores and businesses listed in the

Yellow Pages. Another student says that posters asking for donations of reusable materials could be placed in store windows and that way they could reach many people in the community.

> *One group of students in the Lansing class decided to find the lowest prices of the supplies on their inventory list by conducting a telephone survey of local stores. So that they would remember all the information, they made a data collection sheet with spaces for the store name, address, telephone number, and the person with whom they spoke, plus columns for brands, quantities, and prices of the school supplies. The data collection sheet later provided the students with a simple means of comparing their data. (From log by Elnora Martin.)*

The Collection Group then decides on the priorities of their tasks and makes the following list:

1. Write letters to parents in our class explaining our scrounging and asking for their help.
2. Write letters to businesses and industries asking for free samples, overruns, and discards.
3. Make posters for school.
4. Make posters for local stores.
5. Make lists of "Do Bring" and "Don't Bring" for our classroom and for the distribution center.

Group members then decide to work on one of two major areas, letters or posters.

The letters to parents are quickly written, revised, and dittoed. The children spend more time composing the letters to businesses and industries. While several girls are incorporating suggested improvements into a final draft, the other group members begin listing requested items and types of businesses that might provide them. They combine the following list and then use the Yellow Pages to find nearby businesses:

textile mill (for thread, buttons, material scraps, carpet scraps and spools)
paint/wallpaper and decorating shops (for old wallpaper books, paint cans, old paint brushes and fabric swatches)
grocery stores (for wooden crates, cardboard boxes, paper bags)
glass shop (for Plexiglass, glass, and screen scraps)
building supply companies (for scrap lumber, nails, cement blocks, bricks, linoleum, tile)
beauty salon (for plastic bottles, glass jars)
office supply businesses (for various sizes of boxes)
fabric store (for fabric swatches, remnants, ribbons)

The class in Lansing compared information on their data collection sheets and discovered that a local discount store offered the supplies they needed at the lowest prices. Because the students needed parental permission to go there on a shopping trip and also to visit other school stores in the district, a committee was formed to draft a letter. The group members incorporated the things about their proposed trips which they felt would most interest parents: what the class was working on, why the trips were needed, and what skills the students would learn and use. When the draft was completed, the group consulted with the intern teacher, who made a few suggestions and then typed the letter for them. (From log by Elnora Martin.)

A group of students from the Athens class scrounged discarded items from several local industries. First, they used the Yellow Pages to select twenty-five companies which might be able to supply overruns or discards. Then they composed and mailed a form letter explaining the class activities, and they enclosed a list of items which they could use and also a stamped, self-addressed postcard. Unfortunately, few industries replied, but those that did offered plywood sheets, carpet scraps, and string. (See log by Sherry Malone.)

The group members who are working on posters first consult with the class to decide on a name for the distribution center so that they can include it on their signs. After much deliberation the students finally agree on "Over and Over" Recycling Company, or "O & O," for short.

The Collection Group then uses a map of the school to figure out poster locations and quantities. In keeping with their challenge to reuse items, the students scrounge used oaktag that has one clean side. Other posters are made from old newspapers with letters cut out from scrap construction paper.

The Advertising Group for the school-wide book exchange in Athens used discarded paper to make leaflets, flyers, and posters. Classroom signs were dittoed on used typing paper that had one clean side. To make 900 leaflets, one for each student in school, the group typed five messages per page and then cut them apart. When the supply of used typing paper was depleted, the students resorted to scrounging reusable notebook paper from their classmates. (See log by Sherry Malone.)

Before making posters to display in local stores, the group decides that they should first make several samples and check after school to see if the store managers will agree to display them. The children also visit branch libraries, banks, and the youth center. Later several students return with various sizes of boxes already donated by store managers. Since these are some of the first boxes received, the class decides to keep them in the room for temporary storage of supplies until an area for the distribution center has been set up.

With the posters and letters completed and distributed, some members of this group assist other groups, and several students begin to scrounge items from all areas around the school. They also speak with the cafeteria staff who agree to save gallon cans and plastic bags. The office secretaries likewise promise to save ditto and typing paper that has been used on only one side.

One group of fourth and fifth graders in Plainsfield, New Jersey, was very concerned about the

large amounts of school glue being wasted by students, particularly younger ones. As they felt that children in the lower grades would not be able to read posters, they developed a presentation on the proper way to use glue and paste. They gave their demonstration to all primary classes from kindergarten through second grade. (From log by Barbara Briggs.)

Location Group

The group concerned with the actual setup of the recycling center obtains permission from the principal to convert a small, unused closet into the storage area for their supplies. The principal leaves the complete renovation, including painting and making additional storage shelves, to the students.

An upper-intermediate class of physically handicapped children in Portland, Oregon, decided that their school store needed a display case and counter. The first reaction of several students was to order a case or to have someone else build it for them. However, when they found prices prohibitive, they agreed to try to build it themselves. In designing the case, the Construction Group had to take into consideration the special problems, such as maneuverability with wheelchairs and crutches, of both the store clerks and their customers. Using a meter stick, they figured the needed dimensions of their Tri-Wall display case should be 150 cm wide by 80 cm high by 50 cm deep. The students decorated the case by covering it with contact paper. Later they made improvements by reinforcing the bottom of the case with lumber and by installing casters so that the students could independently move the case into the hall during business hours. (From log by Sharon Baker and Tari Querin.)

Students in one seventh-grade class in Howell, Michigan, were upset when the school custodian insisted on hiring a carpenter to build the display case for their school store. The

students were determined to prove their ability to work with tools and therefore decided to build items to use in their classroom, including a table, greenhouse shelves and cupboards, and a display case for their biology specimens. (From log by Deborah Peters.)

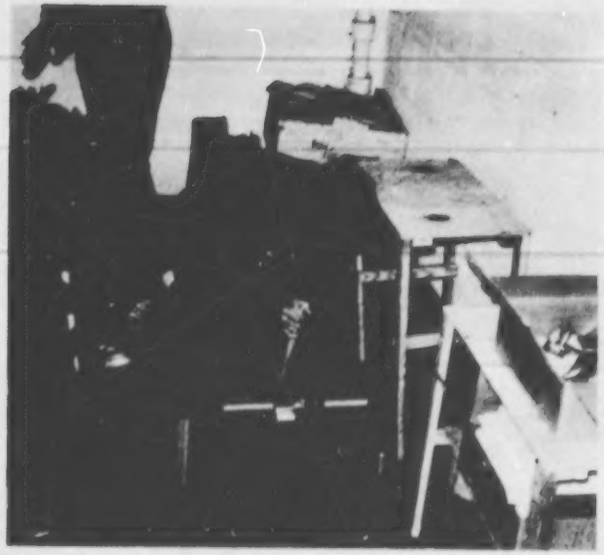
After spending several sessions removing various materials that had been stored in the closet and then cleaning it from ceiling to floor, the Location Group is ready to decorate. One of the boys mentions that his father will donate some leftover yellow paint, and everyone agrees that yellow would make the small, dark closet much brighter. Later the students use old T-shirts as smocks to protect their clothing when they are painting.

Because there are only two narrow shelves along one wall, the group feels that they need more storage facilities. The children are soon involved in a debate over what materials to use; whether to construct boxes, shelves, or tables; and how large they should be. Finally one student says, "Before we can decide any of these things, we have to consider what things we'll be storing."

The other students quickly see that his point is valid, and they consult the bar graphs to determine what quantities of items they will need to store. Several students feel that labeled cardboard boxes stored on shelves would be the best way to stock many of the items because the boxes would serve two purposes: (1) they would keep similar items together, especially smaller items such as buttons, and (2) they could be decorated to give a neater appearance to the distribution center.

This develops another idea from one of the girls who suggests that for items such as baby food jars the best storage method would be one similar to that used in some grocery stores. By obtaining baby food jar boxes and cutting the sides to approximately two inches in height, the boxes could serve as trays for storing the jars which could then be stacked one on top of another. The group concurs that cardboard boxes are a good idea and that collecting them should be top priority.

The discussion then turns to building the shelves. The students feel that the easiest method would be simply to place boards on top of cinder blocks. Several students agree to scrounge the blocks from home, from neighbors and even from a nearby building supplier. Two students check with the Design Lab manager but find that there is no avail-



able lumber for the shelves.

Two boys in the Athens class decided to use lumber scraps for constructing additional shelf space for the school recycling plant. When they presented their plans to the class, someone commented that the shape was "odd." The boys defended their design by explaining that the dimensions represented the measurements of available scrap wood which they felt they should use to comply with their challenge of making discarded items useful. (See log by Sherry Malone.)

At the next meeting several students bring in cinder blocks and then measure them to determine what distance they will have between shelves. One boy's neighbor had told him that the two cinder blocks he donated measure 8" x 8" x 16". But, when the boy measures them, he finds that they are actually 7 5/8" x 7 5/8" x 15 3/8". He holds a quick consultation with the Design Lab manager who explains that numbers are usually rounded off for building materials such as cinder blocks with the 16" x 8" side on the floor for stability. They then calculate that it would take two blocks to a pile to have a distance of 16" between shelves.

In Los Gatos, California, a group of students from a combined seventh/eighth-grade class tried to decide what height to make the counters for their school store. Everyone began to shout out different numbers until one of the girls found a solution. She asked the shortest student in the class to bend his arm at approximately 45° and then to put a mark on the board with his fingertip. She then asked the tallest person to do the same thing. Just as she started to take the average between the two distances, the other students realized what she was doing, and everyone put a dot on the chalkboard. The students later graphed the distance of each dot from the floor and used the median figure as the height for the counter tops. (From log by John Pimentel and Ron Spangler.)

The Ganado class decided to construct a counter for their school store. To obtain dimensions, they compared tables in their room with their own waist heights and checked several people's arm measurements (for counter depth). In addition they checked on the heights of fourth graders to make sure the counter wouldn't be too high. After making a scale drawing, they constructed the counter in the Design Lab. (From log by Sara Keeney.)

The students next calculate how many shelves they will need by estimating the shelf space required for different items. For example, they measure the heights of baby food jars and find that one is four inches and the other three inches. With a sixteen-inch height between shelves, they figure that allowing space for easy removal, they can stack three trays of 4" jars and four trays of 3" jars. As each tray contains 24 jars and measures approximately 14 1/2" x 9 1/4", they decide that by placing the trays sideways, they will need 29" lengthwise to store 168 baby jars in two stacks.

When the group has determined the number of shelves needed, two students telephone several area businesses to find the lowest price for the additional cinder blocks they need; they decide to scrounge the lumber. They record their information and get in touch with the principal and the Design Lab manager who agree that the lowest quoted price is reasonable and that the purchase money could be obtained from the school miscellaneous fund.

In the meantime, some members from this group accumulate cardboard boxes for storing materials. For smaller items, such as sponges, nails, and buttons, they use shoe boxes and stationery boxes. Each box is labeled according to its contents. They also make a sign for the outside door. When the lumber has been cut, painted, and arranged on the cinder blocks, these students help to arrange the items on the shelves, placing those things that have appeared most frequently on the survey at lower levels within easy reach.

Although their original plans have been completed, the group decides that the recycling center still needs a table. Several group members work in the Design Lab designing and constructing a simple rectangular Tri-Wall table which they plan to place in front of the entrance to serve as a counter during distribution times. They feel that this will prevent people from just walking in and taking items without filling

out an order form. The principal gives permission for the door to be locked at other times.

A sixth-grade class in Boulder, Colorado, inherited a display case from classes that had sponsored a school store for the previous two years. Because the sixth graders were concerned that the case had no lock and could be easily opened, one group of boys discussed various security devices. They finally decided to install a padlock, which they mounted so that it closed over the screws, fastening it to the door frame. They also placed a long wooden rod inside the sliding glass door to prevent it from being opened. The boys were later pleased to learn that their security system had foiled an amateur burglary attempt by two younger students. (See log by John Limon.)

The Ganado class built doors to enclose the back shelves which could then be locked. Long-term clerks, working in pairs, were hired by the students from their class members and paid 25¢ each per day. The students devised a job application which they used in selecting the store clerks from their classroom. (From log by Sara Keeney.)

Distribution Group

The third group, which is working on the details of the distribution, devises a simple order form for teachers to use to request items. It includes the name and the room number of the teacher, a space for item(s) and quantity, and the date when needed. The group decides first to place five forms in each teacher's mailbox, along with a letter explaining where to turn in the forms and the hours when requests will be filled. They designate three areas for collection of orders (1) central office, (2) their classroom, and (3) the distribution center during its "open" hours before and after school. Additional order forms are provided at each area.

The students deliberate for quite some time about whether the distribution center should fill requests from individual students. They finally decide that as they are asking other classes to help bring in items, it would be only fair for

them also to have access to the items. The group does worry that they may be so swamped by requests from other students that they won't be able to fill the orders from teachers. They agree that they will post on the center door an up-to-date list of abundant items which are available to individual students; any items in short supply will be reserved for teacher requests as indicated on the survey form. One student opposes free use of items to everyone; he fears that a small number of students may constantly use their items but never help collect them. Most members of the group agree that while this is a possible problem, they also feel that the distribution of supplies should not be prohibited unless the problem actually occurs. As a possible solution, someone suggests listing the children who contribute items; they would then be the only students who would have permission to obtain supplies.

The group presents their distribution plan and alternative to the class, which approves of the free use of excess items to all students. During the class discussion someone mentions that the distribution center may encounter difficulties if the teachers feel that their students are obtaining some things, such as rubber bands, which they misuse during class. The other students concur that this is a matter worth consideration, but they feel that they cannot control the behavior of all the students who visit the distribution center. After further discussion they decide to designate the after-school time as the only time student requests will be filled, thus lessening the chance of student misuse of supplies during class and allowing the workers to devote the morning time to filling teacher requests, taking inventory, and restocking the shelves.

The sixth graders in Boulder decided to expand their school store operation to include a recycling bin from which both students and teachers could select free discarded items. The students agreed that accessibility should be a key factor in the design of the bin. After various designs were drawn, the class voted to choose the one which they felt best suited their purpose. (See log by John Limon.)

During the discussion of the oversupplied items to be available to all students, the Distribution Group realizes that they won't know which items are in excess supply unless they keep a count of their materials. Therefore, they begin

to list the items and quantities that have already been collected and they consult the bar graphs to determine which supplies are still needed.

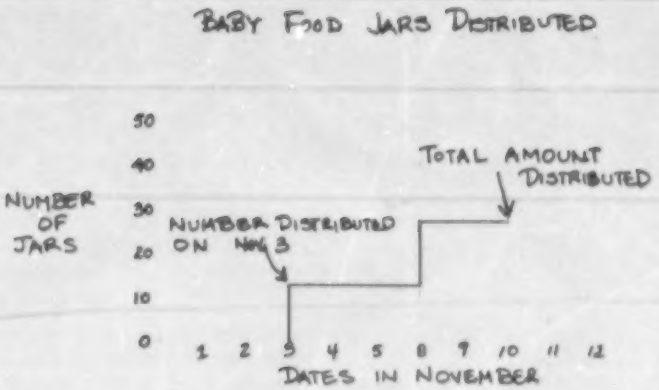


Figure B5-3

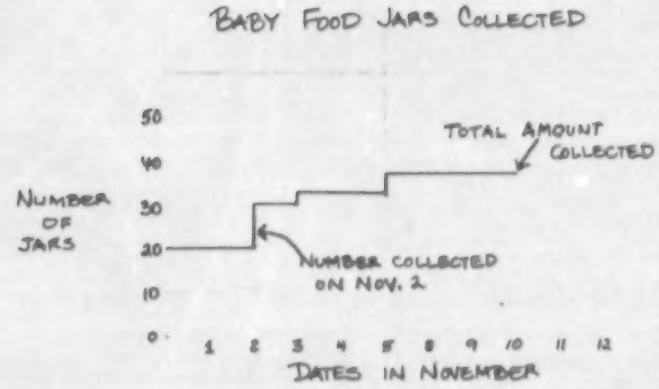


Figure B5-4

A class of first and second graders in Lexington, Massachusetts, collected discarded items to use as "Beautiful Junk" during their free time periods. The children stored the materials on a three-shelf bookcase in the classroom and then decided to take an inventory. They divided into three groups to record their supplies and quantities on a two-column inventory sheet. (From log by Judith White.)

As they are discussing how to design an inventory sheet, one of the students suggests graphing the information. Because no one is quite sure how to set up the graph, the students seek assistance from the teacher who explains that what they need are two cumulative graphs for each item, one to show the quantity of the item brought in and the other to show the quantity of the item distributed. The teacher uses baby food jars as the example. She points out that when the collection and distribution data are plotted on equivalent scales for equivalent time periods, the children can use the two graphs together to find the amount of items in stock. The teacher illustrates by recording the data on distribution on a clear overlay which she places over regular graph paper containing a cumulative graph of the collection data. (See Figures B5-3 and B5-4.) Then, just by subtracting the amount distributed from the amount collected, the children immediately know the exact quantity of jars in the center. One child notes that the line on the distribution graph cannot be higher than the line on the collection graph.

The last task for this group is to schedule times for students to work in the distribution center. They decide that at least two students are needed for each time period, before school and after school. During the first two weeks of operation, they schedule a different pair of students for each time so that everyone initially has an opportunity to work in the center. Afterwards a team of students is assigned by the day. The group passes a two-month calendar around the class, and volunteers are asked to select the time and days they wish to work.

Before the center is open, the class meets to hear final reports from the different groups and to discuss last minute

details. The Collection Group reports that they have received only seven replies from businesses and industries, but among the items that have been offered are cardboard boxes in various sizes, carpet scraps, two small bags of gravel, and scrap lumber. The group adds that they plan to follow up their unanswered letters with telephone calls. They also report that they have displayed their posters and signs and that two students have devised announcements which they will read over the intercom.

Students in Los Gatos who worked in the Publicity Group for the school store devised two types of signs. One type, which promoted student patronage of the store, was displayed in various locations around the classroom, encouraged the reuse of paper and included the slogan, "Save Our Trees By Twice Using These," printed above a drawing of a tree with leaves made from sheets of paper. (From log by John Pimentel and Ron Spangler.)

The Location Group says that all supplies in the center are ready for distribution. For those classmates who haven't seen the finishing touches, the group explains the location of various items, including order forms and collection boxes. The Distribution Group explains their inventory system and repeats the importance of keeping accurate records of both distribution and collection so that an up-to-date inventory can be maintained.

The distribution center is opened, and minor problems are quickly resolved as they arise. Workers also report on the operation to their classmates during class discussions. After a few weeks of operation, the students notice that the center is not being used on an everyday basis; the newness seems to have worn off. Consequently, the class decides to open the center only on Mondays, Wednesdays, and Fridays. "Emergency" orders can be filled on other days.

When the Boulder fifth graders had been operating their school store for about a month, someone asked to see how the sales were going. When the students checked the weekly inventory sheet, they were surprised to find that the sales of the past two weeks were about fifty percent of what they had been previously. One boy jokingly suggested having

a sale to get more customers. The other students thought it was a great idea, and they agreed that as an order for new striped pens would arrive shortly, they should have a sale on the old pens. After figuring the wholesale cost per pen at 9¢, the class decided to reduce their retail price from 19¢ to 15¢. The Advertising Group conducted a quick campaign, and the pens went on sale the following week. The sale was so successful--more pens were sold that week than any other--that the class eventually reduced prices on many other items. (See log by Margaret Hartzler and Kathleen Schultz.)

The students feel a great deal of satisfaction when they are able to fill requests for needed items. Because the response to their solicitation for discarded items has been so great, the workers begin to complain that the center is becoming overcrowded with supplies. Several students note that the primary teachers and the art teachers are the most frequent users, and they suggest that other elementary schools might like to share the goods they have collected. One group of students volunteers to write to nearby schools offering the center resources.

The Athens students found that their recycling plant was becoming overstocked with some items. To reduce their inventory, they offered supplies to the visiting art director of three nearby elementary schools. The director was delighted and gave the students a long list of needed materials including egg cartons, egg shells, plastic bowls, scrap material, magazines, plastic pill bottles, styrofoam meat trays, old light bulbs, and scrap yarn. (See log by Sherry Malone.)

One of the other classes, which has started work on a Growing Plants challenge, requests small clay flower pots. The students check at various locations but are unable to find a free supply. However, they do locate a wholesale pottery company that sells the needed pots for only pennies. The students who obtain the information report to the class. One girl suggests that since the price is so

reasonable, perhaps the class could buy them and sell each of them for 1¢ profit. Other students object, saying that selling for a profit would be a misrepresentation of their function.

Sixth-grade students in Boulder had many debates about the prices they charged at their school store. Some children wanted to charge as much as possible while others argued that the store was a service and therefore shouldn't overcharge. Rather than charging a flat percentage profit, the class usually figured their per unit cost and then added a few cents to it to arrive at their sales price. (See log by John Limon.)

The class is soon involved in a lively discussion about whether or not to sell items. Pros and cons are argued, but everyone does agree that there are certain other supplies that could be sold to students, such as pens, pencils, and notebook paper. However, they finally decide that the flower pots do not fall into the same category. The students who found the low price agree to inform the other class of the source and to let them decide whether to make their purchase there. Several children have become very excited about selling supplies and they suggest that, in addition to the distribution center, the class should operate a school store.

For the remainder of the school year the students continue the operation of their distribution center and, in addition, they organize and maintain a school store to sell supplies to students.

A class of second graders in Iowa City, Iowa, worked on two supplies problems. First, to help them keep track of their supplies, the children investigated the best location for a classroom Lost-and-Found box. After they had selected several sites and were merely collecting data on the most popular and useful location, the students began work on a second school supplies problem that had arisen, a lack of folders for their math work. (See log by Linda Lopos.)

Besides operating their school store, the Ganado class ran a play equipment rental service. After raising funds through a doughnut and popcorn sale, they purchased a tetherball, a basketball, a soccer ball, and a rubber ball. They rented these to other classes for ten cents per recess period. (From log by Sara Keeney.)

6. QUESTIONS TO STIMULATE FURTHER INVESTIGATION AND ANALYSIS

- How can we find out whether the supplies purchased by the school are adequate in quantity (or quality)?
- How can you determine what supplies are needed by other classes and teachers?
- How can you determine what quantities of items are needed?
- How can you display your data so that it is easily read? What kinds of graphs will you make?
- How can you provide for additional classroom supplies that are needed?
- How can you stop supplies from being wasted? What supplies are generally discarded at school that could be reused in the same or a different way?
- Where can you obtain the needed supplies? How can you determine if you are getting the best buys?
- How can you get funds to purchase a basic inventory for your school store?
- What sort of arrangements will you make for distributing discarded items? (check-out system, one item exchanged for another, limited quantity available per class, per student, etc.)
- How can you determine a sales price for items? What will you do with the profits?
- How will you keep track of finances? Where will you keep the money used in making change?

- How can you make sure that other people know what supplies are available?
- How can you arrange the supplies so that they are accessible when needed?
- How can we keep track of the number of each item that we have on hand? How will you know when you are running short of particular supplies?
- What will you do about customer complaints?
- What advice can you give to people about ways to use discarded items? Who else besides people in our school might be interested in your reusable items?
- How can you stimulate sales or use of recyclable items?
- What improvements can you make in your distribution center or school store?
- What will you do with leftover items at the end of the school year?
- What suggestion would you make to the school on the purchase of supplies for next year?

C. Documentation

1. LOG ON SCHOOL SUPPLIES

by Linda Lopos*
Ernest Horn School, Grade 2
Iowa City, Iowa
(September-December 1975)

ABSTRACT

This second-grade class worked on two School Supplies problems simultaneously: (1) to find the best place for a Lost-and-Found box in their room and (2) to make a supply of math folders for themselves and the other primary classes. After the children listed "good" places in the room for a Lost-and-Found box and individual students offered other ideas, a box was placed in each of eight suggested locations. When the boxes had been in their respective locations for about a month, the children conducted an opinion survey of the class to determine which box was used most often. After tallying the results, the class found that the box by the sink was most frequently used. This box remained in the room for the rest of the school year and continued to collect lost-and-found articles.

To make a large quantity of math folders, the class first decided on a design and a size and obtained the necessary materials. After showing samples and taking orders from the other primary classes, the children organized their work into five steps and mass-produced sixty folders. An opinion survey of the class was conducted to decide when and where to sell the folders. The sale was then advertised using posters, notes, and announcements. The children set up a work schedule and sold the folders at regular times each day in their classroom until their supply was depleted. Near the end of their School Supplies activities, the class constructed a flow chart of what they had done to display during "Open House" for their parents and other visitors.

As my second graders began the school year, they found that their first school supplies problem was not how to obtain or recycle school supplies but how to keep from losing them. The challenge arose when the student who was responsible for taking care of the recess equipment (e.g., balls, jump ropes) announced to the class that one of the jump ropes was missing. This led to a discussion of what

*Edited by USMES staff

other supplies, both individual and classroom, might turn up missing during the school year. We first listed the supplies that each person in the class should have: pencils, erasers, crayons, scissors, paint smock, water colors, water container, paper, and glue.

I then asked the children where they would look for things that were missing. One student suggested looking in the area where the object might have been lost, and another stated that she would look in a Lost-and-Found box. Since we didn't have a Lost-and-Found box in the classroom, I asked the class where they thought we could place one. Their suggestions included--

in the back of the room,
in the front of the room, and
in the teacher's desk.

I next asked what would be the most effective way to find out where everyone thought the box should be placed. One girl suggested that each person write a location on a piece of paper and then hand the paper to me. We decided to try out this idea, and everyone listed a possible location. (See Figure C1-1 for a sampling of the suggestions.)

A week later we continued our discussion of the problem of determining the best location for a Lost-and-Found box. Showing the children the list of places they had suggested, I asked what we could learn from the list. The class decided that the list indicated only the places that people *thought* would be best for the Lost-and-Found box, not where the best place *actually* was. One student suggested that a box be placed in each location listed, and everyone agreed that this would be a good way to test the popularity of the various sites. Five children volunteered to find boxes for the locations and another five agreed to keep track of how many things were put in each box.

As the discussion continued, the consensus of the class was that the box collecting the most lost articles would indicate the best location; however, one student felt that we should also ask everyone which box he or she used most often. As a result, a group of three children decided that after the boxes had been used for a while, they would conduct an opinion survey to find out which box each student used most frequently.

One student wondered aloud which place had been suggested most often on the slips of paper. The class then realized that they also needed information on the number of different locations suggested so they would know how many boxes

Chad
The shelf Wire we Keep the book

Susan
Mrs. Moms desk

Range
by the light switch

Figure C1-1

would be needed. Our problems were solved when four girls volunteered to look over the slips of paper to see how many locations were suggested and which location was suggested most often.

As our discussion came to an end, I brought up another supply problem that had developed since our last session: obtaining math folders for each person in the class. I explained that although I had already collected 15¢ from each child to buy math folders, I later found that the store price had risen to 25¢. When I asked the class whether anyone could think of a better way to supply the folders, one boy suggested that we make them, and the whole class agreed. After deciding that the folders should be made from oaktag, the children volunteered to be on committees to do the following:

1. Find our where to get the oaktag and how much it would cost.
2. Find out how much oaktag we would need.
3. Design the folder.
4. Make the folders.

While half of the class experimented with various folder designs, one group of children went to the office to obtain information about oaktag. Another group took apart a pocket folder, measured it to see how much oaktag was needed for one folder, and reported that it was 20½" long and 17½" wide.

When the group visiting the office returned, they reported to the class that packages of 100 24" x 36" sheets of oaktag were available from the school office for $15 per package. The group then figured the cost of one sheet would be 15¢.

When the class met again to work on their supply problems, no one had yet brought any boxes to make Lost-and-Found boxes. The class decided that over the weekend everyone would try to find some suitable boxes and bring them to school. The group working to find out how many locations had been suggested for the boxes began listing each person's name and his/her suggested location on a large sheet of paper.

The group designing folders had completed their task and displayed five different designs for the rest of the class. The more complicated designs were made from two sheets of construction paper and assembled so that there were pockets to hold the math pamphlets. The group also showed the class a sample of the folder that had been used the previous

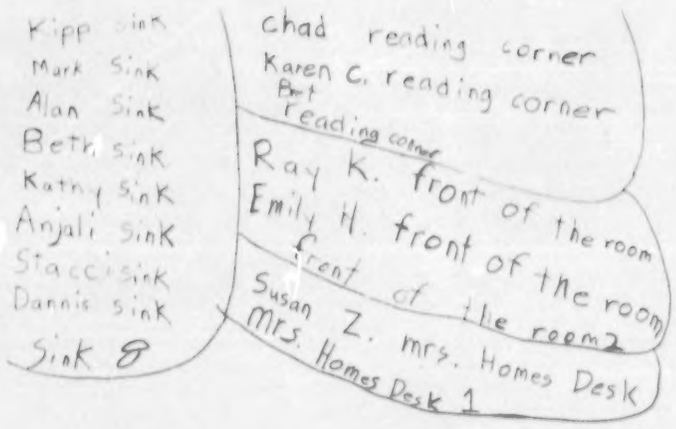


Figure C1-2

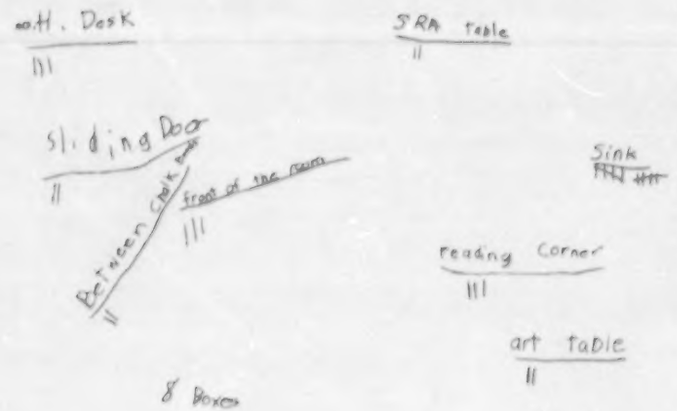


Figure C1-3

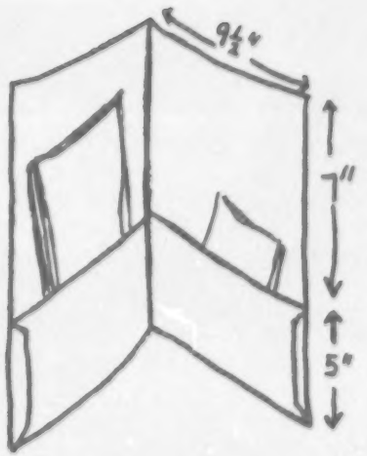


Figure C1-4

year; it was made of only one piece of paper but that piece was larger than the construction paper used to make up the new designs. To decide which folder design to use, the class took a hand vote on whether to use last year's design or one of the new designs. When the hands were counted, we found that the new designs had edged out last year's design by fifteen to twelve.

The children then debated how they would choose the best of the five new designs. They finally decided to settle the issue by a practical test; they would put math materials into each folder and then choose the one that worked best.

When the class met again, still no one had brought in any boxes for the Lost-and-Found locations. I asked the children what we should do about this problem and one of the students suggested asking the custodian for some help in finding boxes. It was a good idea, and three children immediately left to find the custodian.

Next I asked for a class report from the group that was to determine the number of boxes we needed. The group showed the class what they had done so far (see Figure C1-2), and I asked whether anyone could think of an easier way to find the number of times each location had been suggested. One girl said that we should write down the name of each area once and then list the children's names under the areas they suggested. I then asked whether we needed to know the names or just the number of children for each location. The class agreed that only the number was important. Another student then stated that lines, e.g., tally marks, should be placed under the areas suggested rather than names. The group then returned to the task of organizing their information and later reported that eight locations had been suggested; therefore, eight boxes were needed (see Figure C1-3).* Meanwhile, the students who had left the room returned with eight boxes supplied by the custodian and placed them in the suggested locations.

We next selected by a hand vote one design from the five submitted (see Figure C1-4). By opening up the winning design and placing it on the oaktag, the students determined that two folders could be made from each sheet. Several children made samples of the folder, and the following day a group of four girls went to the other primary classes to show them our design and to ask how many children would be interested in buying one. Fifty-eight folders were requested.

*The children might put their data in chart form and perhaps later display it on a bar graph.--ED.

1. Put an X in the box next to the place where we would sell folders. (Students were to mark only 1)

- ☐ our room
- ☐ gym
- ☐ by front door of School
- ☐ other_____

2 Put an X in the box next to the best time to sell folders. (Students could mark more than 1)

- ☐ right after school
- ☐ during any recess
- ☐ between 8:20 and 8:30

Figure C1-5

At the next class session, the children discussed how they would make the folders. They listed the following steps:

1. Cut the sheets of oaktag in half.
2. Trace an outline of the folder on each piece.
3. Cut out the outline.
4. Fold each piece into a folder.
5. Glue the tabs of the folder.

The class decided that five children should work on each step (there were twenty five children present that day). After all had volunteered for the job of their choice, stations were set up in the room for each task. While some groups waited to begin their step, they worked on making signs for the Lost-and-Found boxes.

Soon each group was working on their step of the folder-making process. Many children, however, hurried through their task and did a sloppy job. A few students who were aware of this complained. At clean-up time, I asked the class how things were going, and several children commented on the sloppy work. When I asked why they thought this was happening, one child stated, "We were so excited, we wanted to hurry." Other children made suggestions for improving the quality of their work: (1) have a "checker" for each group, and (2) schedule more time to work on the folders. Because it was dismissal time, the class decided to continue their discussion the next morning.

When we met again, the class offered many suggestions for improving the sloppy work:

All Groups:	• Work slowly and carefully.
Tracers:	• Have one person hold the pattern while another traces.
Cutters:	• Make sure you cut *on* the line.
Folders:	• Before folding, make a line to show where to fold.
Gluers:	• Before gluing, check folded areas carefully.
	• Wipe excess glue with a paper towel.
	• Hold the glued part down for a count of twenty-five.

The class also decided that one person from each group should inspect the work being done.

The groups then returned to making folders for about twenty minutes. The checkers rejected poorly done work,

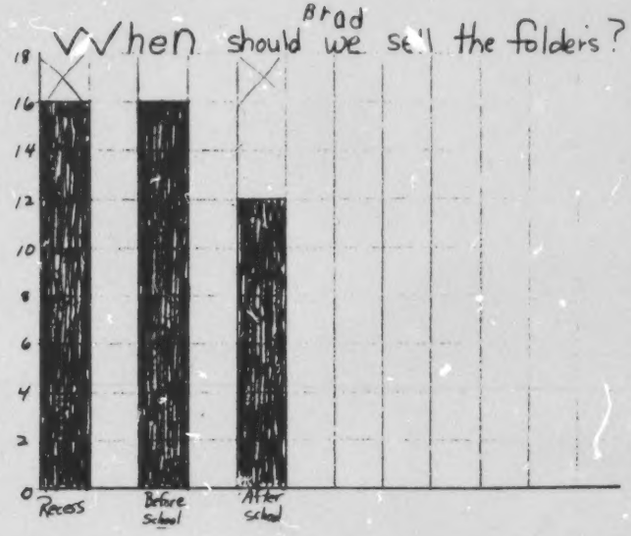


Figure C1-6

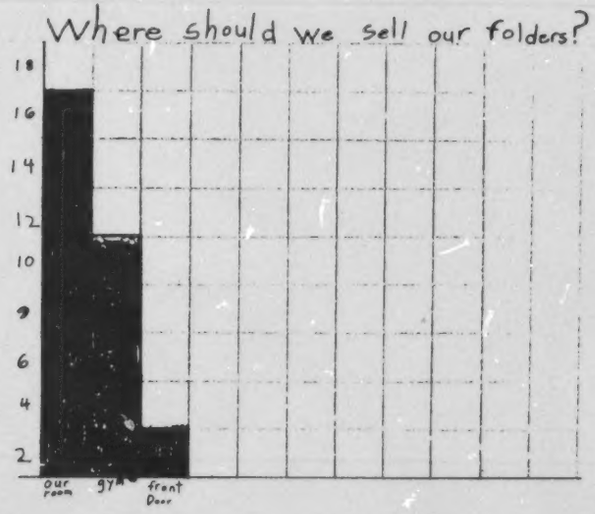


Figure C1-7

and most of the children were more particular about how they did their tasks. It was obvious that they were taking pride in their work.

After we had spent two more class periods on construction work, the stack of completed folders was quite large, and some of the children began asking when they could start selling them and whether they could make posters advertising the sale. A group of four girls decided to figure out when and where they could sell the folders. They thought that they should survey the other primary classes, as well as our own class, to find out a good time to sell the folders (e.g., lunch period, recess, library period).

At our next class discussion the girls brought up the idea of the survey with the rest of the class. A majority of the children didn't want to ask the other primary classes where and when to sell the folders; rather our class alone, they thought, should decide these things. As a result, a new group was formed to develop a survey just for our class.

When the new Survey Group met, they decided that the survey should include two questions:

1. Where should we sell our folders?
2. When should we sell our folders?

I asked the group how many different answers to these questions they might get from the class, and one girl realized that there should be a selection of times and places on the survey. After revising the survey to include these choices, the group made a ditto master and ran off twenty-seven copies (see Figure C1-5). The class was allotted about ten minutes to answer the questions; then the group collected the results on the board:*

Where		When	
Gym	10	Recess	16
Our room	16	Before school	16
By front door	2	After school	12
Other	0		

I asked the class whether anyone could think of another way to show this data. One girl with previous USMES experience said that we could make a graph. Most of the children were interested in this idea, and so, two groups of ten children

*Students were allowed more than one vote.--ED.

Go to Mrs. Lopos' Room for folders. At 8:20 or 8:30 in morning and afternoon recesses.

The sale will begin Thursday, Oct. 9th. They are 10¢ each

Figure C1-8

There will be a sale of pocket folders in Mrs. Lopas' room beginning on Thursday. The folders will be 10 ¢ each. You may come between 8:20 and 8:30 any morning or during morning and afternoon recesses. This does not include lunch recess.

Figure C1-9

Figure C1-10

Put a x in the best place you think we should sell folders.

☐ Art center

☐ In front of the room.

☐ Reading table

☐ Other _____

were formed to make two bar graphs. After finding that each box "should be worth two" the children were able to complete their graphs with little difficulty. (See examples in Figures C1-6 and C1-7.)

Meanwhile, the seven children who were not interested in making graphs discussed who would sell the folders and when they would do it. One girl suggested setting up a schedule to make sure that everyone had a turn at selling. The group also talked about where in the room would be a good place for selling the folders.

Since sixty folders had been completed, the class met to decide how to advertise and sell them. The following suggestions were listed on the board:

1. Make posters.
2. Make notes to pass out to the primary classes.
3. Announce the sale of folders to other primary classes.
4. Survey our class to find out where in the room the folders should be sold.
5. Make out a work schedule for those interested in selling.

The children volunteered to work in one of the five groups. The Poster Group designed posters on "practice paper." They planned to copy their designs onto oaktag and color them with felt-tip pens.

Another group of six children composed a note to be distributed to each primary student and wrote it on a ditto master (see Figure C1-8). Two members of this group got in touch with the other primary teachers and obtained the number of children in each class. They then ran off the correct number of copies on the ditto machine.

After making four copies of an announcement of the sale (see Figure C1-9), the Announcement Group used their recess time to practice their parts. They then made the announcement to the other primary classes after recess.

The Survey Group decided that the three best places in the room to sell the folders were the art center, the reading table, and the front of the room. They listed these places on their survey (as well as "Other") and asked their classmates to choose one of them as the best place to sell the folders (see Figure C1-10).

After the survey had been given and tallied, the Survey Group reported the following results:

8:20 - 8:30	Linda trent Mike Morning recess	Afternoon recess
Mon. dennis Emily	Ray Brad	Ellen Linda
Tues. Kipp Marc	Stacci Chad	Linda Dawn
Wed. Elizabeth Susan	Bret Karen	Ellen Karen
Thurs David Alan	Sarah Anjali	
Friday Doug Dawn	Bret Kipp	

Figure C1-11

Figure C1-12

Which box did you use the most, put an X in the box.

sink ☐

mrs, Homles ☐

front of room ☐

between chalk bards ☐

at Super Books ☐

Art center ☐

Reading corner ☐

93

Thank you!

Art Center	11	Reading table	6
Front of Room	10	Other	0

When I pointed out that use of the Art Center would be limited because it was needed for art activities, the class voted overwhelmingly to use the front of the room instead.

The Work Schedule Group made a chart of times and days for selling folders. After eliminating the names of the seven children who did not wish to sell folders, they filled in the schedule with the names of the remaining twenty students (see Figure C1-11).

The groups continued to work on their tasks and completed all preparations for the sale. The posters were hung in all the rooms of the Primary Unit and the work schedule was hung in the front of our classroom.

Our sale of the folders was very successful. The students followed the work schedule carefully and visited the other primary classrooms to remind people that the folders were on sale. They were quite disappointed on days when no sale was made. After several weeks, when sales began to dwindle, the work schedule was discontinued and announcements were made in each room that folders were still available before and after school. We continued our sales promotions until all folders had been sold.

Several weeks after the sale of folders began, several students said they were curious about which Lost-and-Found boxes were being used most often. The class devised a survey (see Figure C1-12), and when the results were tallied, we learned that the box by the sink was in the most popular location. The other boxes were removed from the room, and the Lost-and-Found box by the sink remained in that area for the rest of the year where it continued to collect our lost-and-found articles.

Near the end of our work on the School Supplies challenge, our school held an "Open House." I asked the students how we might tell visitors to our room what we had been doing, and they suggested writing everything we had done on the board. Together, we constructed a flow chart of our School Supplies activities (see Figure C1-13). When the chart was finished, the students enjoyed following the arrows and reading from the boxes the story of our activities.

Beaming faces, giggles, and sighs showed me their feelings of pride and accomplishment in the work they had done.

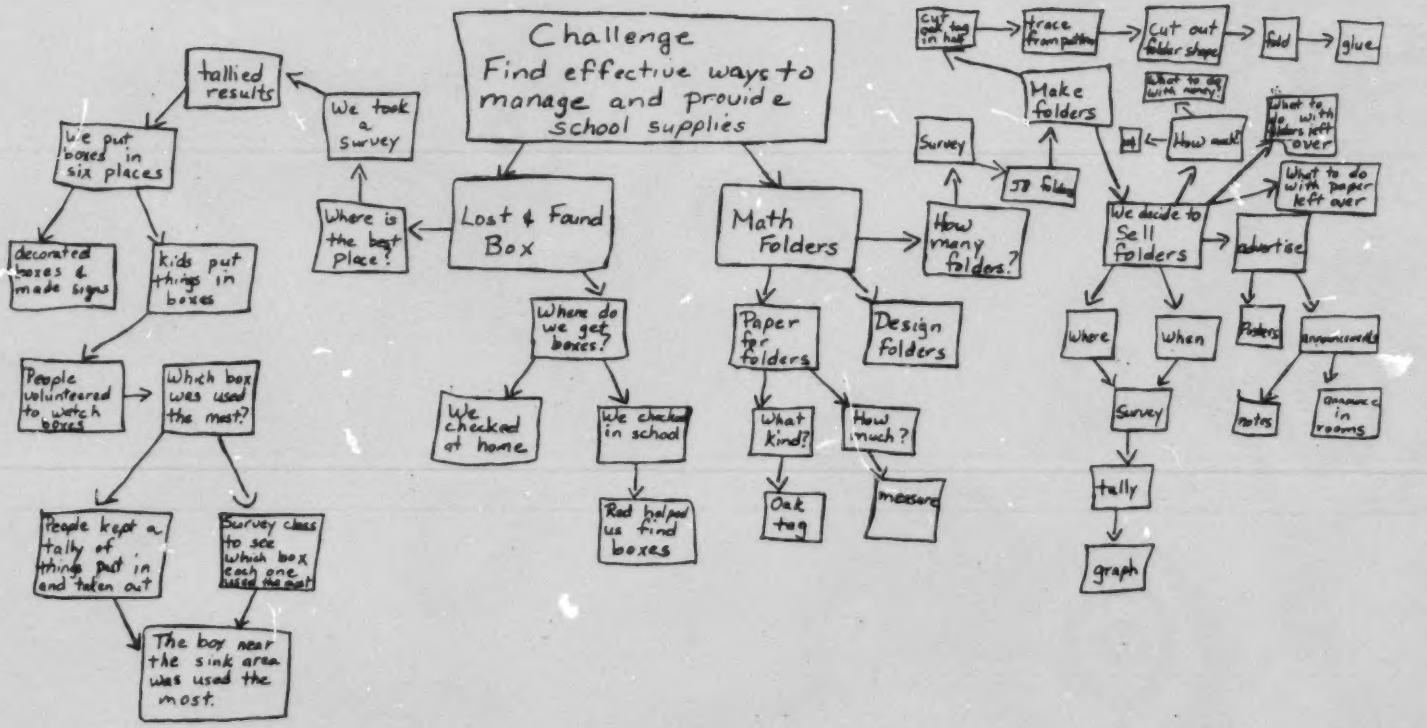

Challenge
Find effective ways to manage and provide school supplies
Lost & Found Box
Where is the best place?
We took a survey
tallied results
We put boxes in six places
decorated boxes & made signs
kids put things in boxes
People volunteered to watch boxes
Which box was used the most?
People kept a tally of things put in and taken out
Survey class to see which box each one used the most
The box near the sink area was used the most.
Where do we get boxes?
We checked at home
We checked in school
Red helped us find boxes
Math Folders
Paper for folders
Design folders
What kind?
How much?
Oak tag
measure
How many folders?
Survey
Make folders
cut oak tag in half
trace from pattern
cut out folder shape
fold
glue
What to do with money?
How much?
What to do with folders left over
We decide to sell folders
What to do with paper left over
advertise
where
when
Posters
announcements
Survey
notes
announce in rooms
tally
graph

Figure C1-13

2. MINI-LOG ON SCHOOL SUPPLIES
Surveying, Ordering, and Pricing Items for a School Store

by Margaret Hartzler and
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Heatherwood School, Grade 5
Boulder, Colorado
(September 1972-June 1974)

ABSTRACT

Two classes of fifth-grade students in Boulder, Colorado, determined which supplies to sell in their school store by conducting separate surveys of parents, students, and teachers. Each of the three survey groups displayed the results on separate bar graphs and then compiled all their data on one graph. Those items receiving more than 100 votes were selected as the basic store inventory. The students asked for assistance in pricing items from a local supplies store, which sent a representative to explain the details of ordering and to suggest various methods of calculating retail prices. One group of students also did research on sales tax and found that the store was responsible for a 3% county tax on all sales. The classes maintained a weekly inventory, and when sales were lagging, they increased business by offering a sale on pens. The following year two new classes of fifth graders assumed responsibility for operating the school store. At the end of the second year of business, the students sponsored a closing-out sale and then auctioned off the remaining supplies to the student body. With their profits, the classes purchased a glass display case and a complete potter's wheel for the school.

Our combined classes organized and then maintained the Heatherwood School Store, which sold school supplies for two consecutive years. After the first year, the students passed on the responsibilities of the store operation to the upcoming fifth graders. Over the two-year period the students were involved in all phases of the store management and in two other USMES units, Consumer Research and Manufacturing, which were direct outgrowths of work on the School Supplies challenge. Several of the children's activities and investigations are detailed in this mini-log.

Among the foremost priorities of the students who first worked on the school store was selecting the items they should sell. They decided that since parents, students, and teachers would all be concerned about the store mer-

*Edited by USMES staff.

chandise, each of these groups should have a voice in our decision making. Accordingly, the students formed three committees, and we spent the entire month of October devising and conducting separate surveys of each group (parents, students, and teachers) and then analyzing the results. All three sets of data were compiled to help determine which items should be sold in the store. The work of each survey group is described in the following paragraphs.

Surveying Parents

The group first discussed how to take the survey. One of the boys suggested that we follow the same procedure used for sending school notes to parents, that is, we should send the notes home with the youngest child in each family. With the distribution method decided, the students quickly composed the notes, which gave a brief explanation of the survey and asked the parents to list five items that they thought the store should sell. (See Figure C2-1.)

Dear Parents,

Mrs. Schultz' and Mrs. Hartzler's 5th grade classes are going to set up a school store. We would like to know what kind of supplies you would like to have us sell. Please list 5 of the most important items and return this list to school.

Thank you

1.

2.

3.

4.

5.

Figure C2-1

After the notes were dittoed, the children practiced what they would say when they delivered the surveys to assigned classes. Each group member then counted thirty survey forms and delivered them to the appropriate room. The students themselves mentioned the importance of keeping accurate records of the number of surveys distributed. I was very pleased, since only one or two of the children had ever taken part in a survey and no one had previously administered one.

As the responses came trickling in, the children collected them from the teachers. The group then met to discuss how they would tally the surveys. They finally decided that each student would read the suggestions from his/her returned forms while two other students recorded the items and the votes on the chalkboard. Three boys then copied the total tally from the board so that we would have a record of our results.

We later discussed the clearest way to present the information to the principal for his approval. The students mentioned graphing right away, but as we began to talk about organizing the data, we saw that some items had as many as 230 votes and that more than twenty items had fewer than 10 votes. At first the group decided to vote on whether or not to include those items with 10 or fewer votes on the graphs. However, these items were so numerous that they later decided to vote on only those items receiving 5 or fewer votes. The students reasoned that if only five parents in the school wanted those items, maybe they weren't worth selling.

When two boys presented to the group a list of the items with 5 or fewer votes, many of the students immediately noticed discrepancies with our original tally.

"Hey, glue got more than one vote!"

"Mechanical pencils got more votes than that!"

It seemed that the three boys who had copied the total tally from the board provided us with three different versions rather than the check system we had hoped for. We realized that to get an accurate tally, we would have to recount all the surveys.

We had spent a lot of time on these surveys and no one was happy about starting all over again, but we did. The second time around, however, we changed our tallying procedure. Each child was responsible for recording seven or eight surveys on the board, and our counting went much faster--one hour and we were done.

As we were completing the second tally, I asked the students, "If you were going to do this again, what would you do differently?"

The answers really came flying back: "We should list the items and have parents check them. Then we'd know what kind of paper they were talking about." (Among our responses were tablets, pads, paper, 10¢ pads, notebook paper, etc. We had a difficult time deciphering all these.) Also they thought it would be easier to have the teachers return the surveys to the office. The students had made several trips to each class only to find out that the teacher had lost the surveys or had forgotten to hand them out or that some other disaster had occurred.

Everyone agreed that rather than voting on items with 5 or fewer votes, we would simply eliminate them from the graph. The students were really excited when I distributed the graph paper, and they immediately started counting the squares. Our grid had forty-eight squares, and since some of our twenty-five items had as many as 230 votes, one student announced that each square should stand for 5 votes. Another boy suggested writing the item names on a separate piece of paper and attaching it to our grid because there was no additional space on the graph paper. (See Figure C2-2 for facsimile of his graph.) No one seemed to consider changing the day or the number of votes per square.

A few of the children did encounter problems when they were graphing. For example, one boy, who was trying to represent thirty-nine votes by using five votes per block, correctly counted up six blocks to represent thirty votes. Yet for the nine botes, he filled in nine squares. I mentioned that his graph might be difficult to read if he

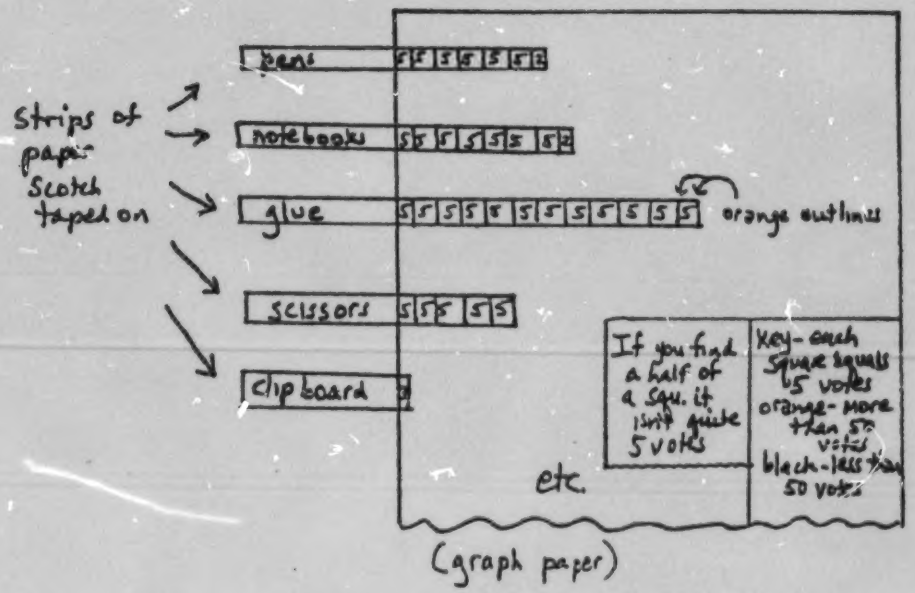


Figure C2-2

mixed his systems, but he didn't understand. We went through how he could mentally divide the square into five parts. That wasn't clear, so I took a square and said that it could equal four votes on a different graph. Then, if he had twenty-eight votes, how many would he fill in? Seven. If he had nine votes, how many filled squares? Two and part of the next square. I divided a square into four equal parts and filled in two whole ones and a quarter of the next one. The light flashed! He went back to his own graph, and, for the thirty-nine votes, he again counted six squares for thirty votes, then added one more square, and colored in approximately four-fifths of the next square.

After all the students had completed their graphs, they decided to choose the best one to show to the principal. Each graph was displayed so that everyone in the group could view it. When the students voted, they selected a very simple one which had been done in pencil. I asked the boy who had made this graph what he planned to say to the principal. He replied, "Tell him each square stands for five votes, and it's for the school store, and if he sees one he doesn't like, he can cross it off."

I heard a small voice in the background mumble, "I hope he doesn't cross off the comic books." Someone seemed to have a premonition of what was to come, for the only item our principal deleted was comic books.

Surveying Students

One boy in this group suggested that we survey the youngest child in each family, but another student quickly pointed out that we wanted the ideas of all the children, not just those of one child per family. Two additional methods for surveying were then suggested.

The first idea was to send a note to each student in school asking for a yes or no vote on a list of items, with additional space provided for other suggestions. While discussing this method, the students realized that this format would be difficult for kindergarten and primary students who could neither read the survey nor fill it out. Someone asked if we needed to survey *every* student, and a heated argument followed. From the argument came the second suggested method, sending a note to all the teachers requesting that they poll their students and return their top ten suggestions to us. The group voted for this second method.*

After composing the survey form (see Figure C2-3), one child went to the office to get a count of the number of teachers, and three other students compiled a list of teachers' names. I typed and dittoed their note for the next session, and the children chose partners for distributing the survey to the teachers.

Later this group tallied their data but didn't think of putting their information on a graph until I started to draw one on the board. Then they were very eager to continue, and they took over where I had stopped. Because they weren't working with numbers as large as those of the Parent Survey Group, it was easier for them to graph their data. One student wrote all the items and votes on the board. They looked over the total tally and decided to graph those items with 5 or more votes separately from those with 5 or fewer (see Figure C2-4).

When the graphs had been completed, the students analyzed their data. Looking at their graphs, they decided that seven votes would be a good cut-off point; they would eliminate items with fewer votes from further consideration.

Heatherwood Teachers----

Mrs. Hartzler and Mrs. Schultz' classes are planning a school store. We need the opinion of your class to help us decide what to sell. Please ask your children to suggest items to sell. Then vote to find ten items and send a list of those ten items to Mrs. Hartzler. Thank you for your help.

Figure C2-3

*The children might discuss whether obtaining a list of items from each class would give them enough information about the quantity of each item to buy.--ED.

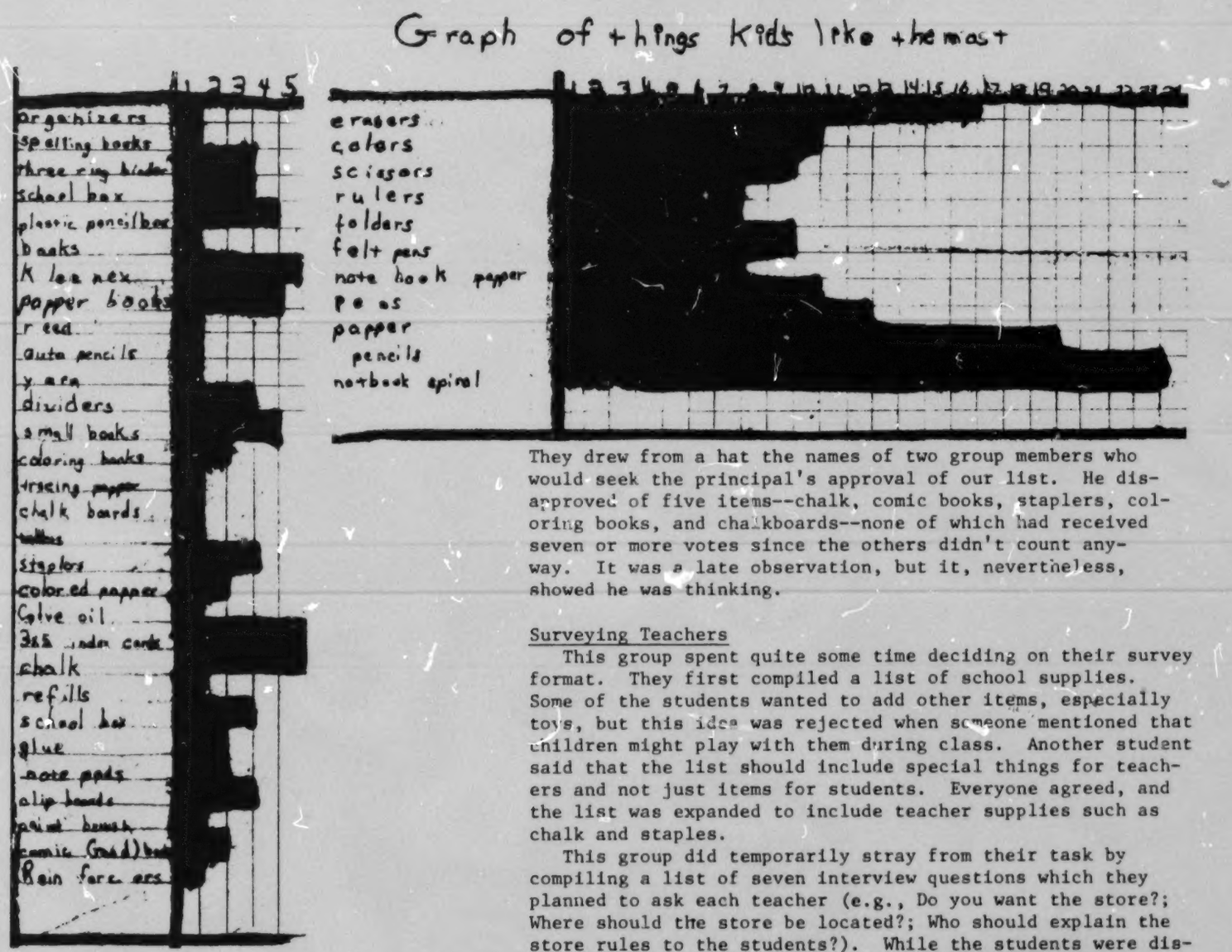


Figure C2-4

They drew from a hat the names of two group members who would seek the principal's approval of our list. He disapproved of five items--chalk, comic books, staplers, coloring books, and chalkboards--none of which had received seven or more votes since the others didn't count anyway. It was a late observation, but it, nevertheless, showed he was thinking.

Surveying Teachers

This group spent quite some time deciding on their survey format. They first compiled a list of school supplies. Some of the students wanted to add other items, especially toys, but this idea was rejected when someone mentioned that children might play with them during class. Another student said that the list should include special things for teachers and not just items for students. Everyone agreed, and the list was expanded to include teacher supplies such as chalk and staples.

This group did temporarily stray from their task by compiling a list of seven interview questions which they planned to ask each teacher (e.g., Do you want the store?; Where should the store be located?; Who should explain the store rules to the students?). While the students were discussing when they might be able to conduct their interviews, I joined their discussion and asked why we had originally decided to conduct surveys.

"To find out what to sell in the store," replied one student.

Teachers Survey

Supply List

1. notebooks ____
2. pencils ____
3. paper (wide lined) ____
4. crayons 8,16,24 ____
5. erasers ____
6. pens ____
7. rulers ____
8. glue ____
9. school boxes ____
10. pencil holders ____
11. spiral notebooks ____
12. Big Chief tablets ____
13. dividers ____
14. clip boards ____
15. flash cards ____
16. scissors ____
17. kleenex ____
18. construction paper ____
19. protractors ____
20. staples ____
21. tape ____
22. magic markers ____
23. chalk ____

113 Figure C2-5

Another asked, "But what about these other things?"

"Well," answered a third group member, "we'll just have to think about them later."

They were back on the right track again. They scrapped their list of questions and dittoed their list of possible supplies (see Figure C2-5). Later, the group divided into two-member teams and administered the survey whenever the teachers were available.

When the group met to compile the data, two girls were chosen to make a master tally sheet on the chalkboard. One girl recorded the responses as the other group members, in turn, read aloud their answers. After reviewing the tallied information, they decided that the store should consider selling all items that received 5 or more votes, thus eliminating pencil holders, clipboards, construction paper, staples, and chalk.

Several members thought that the tallying was finished, but someone mentioned that they had not yet taken care of the "other" category. One student suggested using all the "other" items, but one of the girls said, "If only one teacher wants it, it's not worth it." The additional tallying was soon completed, and again they voted to eliminate those items that had received fewer than 5 votes.

At the beginning of the next session, we reviewed the master tally sheet. I mentioned that it was difficult to see which items were the most popular, and I asked the students whether they knew of any better way to show their information. Since there were only blank looks, I went to the board and started to draw a grid. Immediately two girls said, "Oh, a graph!" They then told me exactly how it should be set up. Each student made an individual graph and wrote an explanation for it. (See example in Figure C2-6.)

When the graphs were completed, we met as a group to review them. The students chose one graph and one explanation and then drew from a hat the names of two students who would check with the principal for approval of the list. (They had seen the name drawing in the other group and had decided to follow the same procedure.) The only item that the principal eliminated was chalk. One of the girls then made a list of the items that had received 5 or more votes (see Figure C2-7). She planned to use it to compare with the survey results from other groups.

By the end of October we were finally ready for all three survey groups to compare their data. A representative from each group listed the most popular items on the board. As we were reviewing the three sets of results, I noticed that

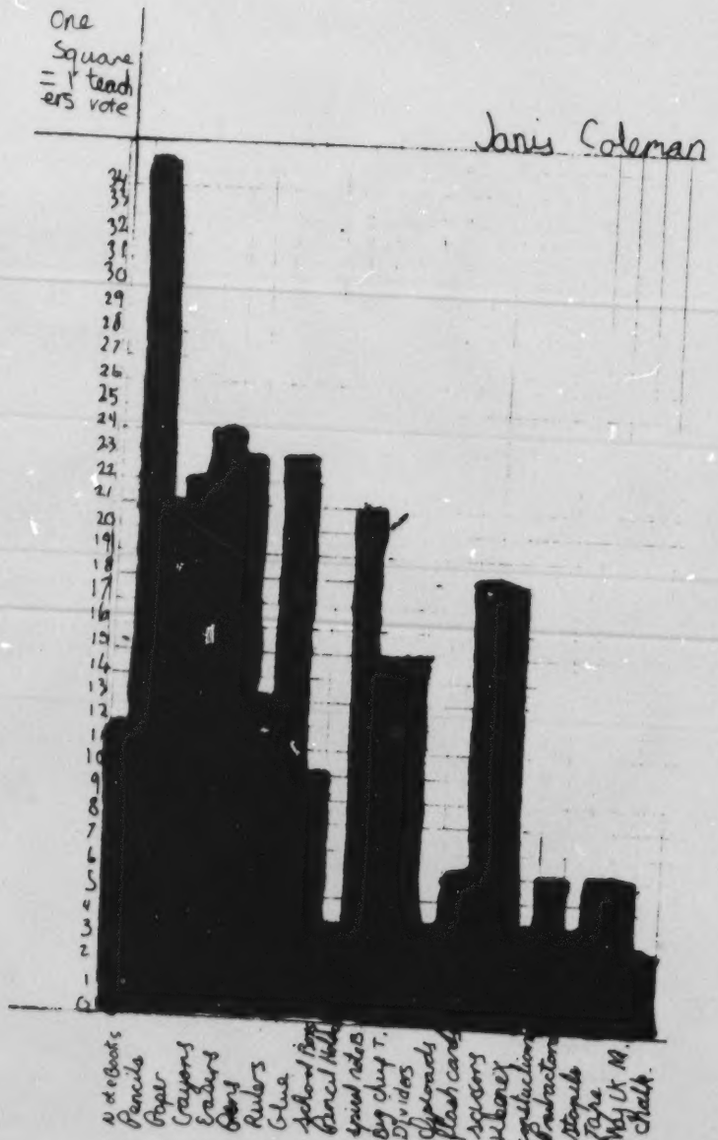


Figure C2-6

the most popular things Teachers Survey

notebooks
pencils
paper
crayons
Erasers
pens
rulers
glue
school boxes
Spirol note books
Big Chief tablets
dividers
flash cards
scissors
kleenex
protractors
tape
magic markers

Figure C2-7

one vote did not represent the same number of people for each survey, i.e., in the student survey, one vote stood for an entire class. At first some of the students wanted to disregard all our data, but others voted them down. However, no one seemed to have any idea of how to solve our problem. I finally suggested that if we used the average class size, we could convert the class votes into individual votes. Two students went to the office to get a list of class sizes.

In the meantime, we discussed how to go about finding an average class size. One of the girls quickly said, "Add up the numbers and divide by how many classes." She wrote all the class sizes on the board and added the column of numbers. She and I got different answers, so everyone in the class worked together to add the numbers. To check our answer, we used an easier method. We multiplied all the like numbers and then added these. Our "average" gal came back to the board and divided our total sum by the number of classes. We rounded off her answer to twenty-six pupils per classroom.

At the next session we multiplied the class vote for each item by twenty-six. Then I asked, "What do you notice about these numbers?"

"They are all in the hundreds."

"They are lots bigger than the others."

We figured out that this was because not all parents had responded to their survey, but all children had voted in their classes. One of the girls made a master list of our three survey results.

Master List ---	sum of 3 surveys
Spiral notebooks	52
Paper	608
Notebooks	648
Glue	79
Pencil bag	7
Felt pens	270
Tablet pad	39
Primary pencils	10
Pencils	758
Rulers	211
Crayons	347
Kleenex	32
Colored paper	11
Erasers	513
Pens	299
School box	9
Dividers	8

Master List	---	sum of 3 surveys (cont.)
Scissors		298
Flashcards		6
Protractors		6
Tape		6
Magic Markers		6
Folders		182

When I asked how we could see our information more clearly, I added, "Have you ever heard that before?"

Heads were nodding all over the room as the children shouted, "Graphs!!"

Because some of the numbers were so large, someone suggested making two graphs, one for items under 100 votes and one for the other items. One of the girls said that each square should represent more than one vote, and a boy remarked, "Make a picture of each thing." With so many ideas pouring in, I told the students to work with a partner to devise the best graph they could.

When all students had completed their graphs, we again met in a large group. Many different kinds of graphs were made, some of them quite complicated. I praised all their fine work but also emphasized that for our purpose the graph should be very simple so that we could find the information we wanted at a glance. Several of the children had not started the bases of their bars on the same line, and so we discussed the importance of a straight-line base for accurate results. The students then voted for several graphs which were easiest to read.

Our next task was to analyze our information to determine which items to sell. One boy suggested that all items with 100 or more votes should form our basic inventory. Someone else suggested that the amount of money we had to work with would also be an important consideration.

With the survey completed, we decided to consult our original list of priorities to help us decide our next direction. We discovered that our proposed tasks fell into the following two major groups:

Organizing	Building
1. Where to get things to sell?	1. Where to put it?
2. How many to order?	2. How to build it?
3. What price?	3. Where to keep money and supplies?
4. Advertising?	
5. Hours, manpower, etc.	

One of the students suggested, "Let's split up--then we can work faster." Accordingly, the sixty students selected one of the two main groups, and we two teachers each worked with one group.

The group working on the organization of the store began by comparing prices in four supplies catalogs that they obtained from the school secretaries. The students worked in pairs to price all items that had received more than 100 votes. Then the fun began! We suddenly were looking at "reams," "gross," "sheets per pkg.," "dozens," etc.--multiplication all over the place!

Just as we were making progress, one of the boys piped up, "Why are we pricing all these companies that are far away? We need things quickly, so why not buy them locally?"

Everyone was silent while we mulled over his suggestion. The students agreed that it was really an excellent idea. We spent the next few days trying to determine how many of each item we would need. The students were really lost trying to solve this problem, and I felt the same. Our conclusion was to seek expert help. Someone suggested asking the local supply office for assistance, and that is what we did.

A supplies representative visited our class to answer some of our questions abour quantities to order, prices for large and small orders, discounts, delivery, taxes, etc. He offered us a straight 25% discount on all items, regardless of the quantity ordered, and said that our first order would be delivered from the store to the school; we would have to pick up subsequent orders. He was really kind and later increased our discount to 30% when we were short of funds.

Because he did not have his supply catalog with him, the representative came another day to help us determine quantities of supplies to order. We began with pencils. He found in his catalog that they came by the gross, 144 pencils. Many of the students started randomly guessing various quantities to order and finally they started to think in terms of their own buying habits. Most of them said that they would definitely use the store when it opened and that they would probably buy from 2 to 5 pencils apiece. We then calculated that if every one of the almost 800 students in our school bought 2 pencils, we would need to stock at least 1600! One of the girls noted that not every student would buy 2 pencils and eventually, we agreed to make our order for 800 pencils, an estimate based on half the students buying 2 pencils apiece. Dividing 800 by 144, we found that we would need between five and six gross. We agreed to order six gross and later assess the sales rate by keeping a close watch on our inventory.

We used the same method to estimate the quantity of paper to order. With two of the twelve items priced, the students decided to tackle the others on their own. They were very conservative in their estimates because they were concerned that they would be left with a large inventory if our store should flop. Completing our order was a very time-consuming task but terrific for all the math skills used.

Another major task was determining our selling prices. Many of the items, such as paper, came with a predetermined price printed on them. However, our best seller, pencils, was not one of these. The wholesale price for pencils was 4½¢ apiece. Some children suggested a sales price of 3¢ or two for 6¢, but others quickly saw we would be losing money. The children again looked to the office supplies representative for assistance, and someone asked, "What would be a fair profit?" He suggested several prices, including 7¢ or 8¢ each or one for 9¢, two for 15¢. He added that they could figure out an arrangement of this nature for four pencils or for any number they wished. A great debate followed! Eventually, the students decided on the one for 9¢, two for 15¢ plan since it would encourage people to buy more than one pencil and it was less complicated than some of the options.

When the supplies representative received the quantities of items we wanted, he totaled the bill and telephoned to tell us the news--$124.95.* Although the PTO had agreed to loan us $100.00 to start the store, we were still short of money. The Organizing Group held an emergency meeting and decided, temporarily, to exclude the large packages of paper and the glue. That made our total order just under $100.00.

In the meantime, one group of students investigated the laws, particularly regarding taxes, which might affect our store. The group first discussed who might be able to help them find the needed information. They listed the following sources and then narrowed the possibilities to those that are underlined:

President of U.S.	Lawyer
County Commissioners	Chamber of Commerce
Governor	Internal Revenue Service
Police	Better Business Bureau
Sheriff	

*The students might calculate the bill themselves and then make changes in the amount of items ordered, if necessary. --ED.

When the students tried to telephone various offices, they found that most provided little or no information and offered no assistance. The University Legal Aid did suggest that we look through a copy of *Colorado Revised Statutes*.

The students finally asked for help from our principal who contacted the school accountant. We learned that according to official policy we were required to file a 3% county sales tax but not the 2% city tax because our school was outside the city limits. We obtained a tax chart for use by store cashiers and forms for filing. The news was relayed to the other students, and everyone agreed that the best way to keep track of the taxes would be to set aside 3% of our total sales every Friday when our inventory was taken. The students discussed writing up individual sales slips for each purchase, but they recognized that this would be too complicated and time consuming.

* * * * * * *

On the first Friday after our store opened in January, I met with the clerks who had worked during the week to take our first inventory. The students tallied the number of each unsold item and entered it on our inventory sheet. As we had also received a new order of pens, these, too, were counted and added to the inventory. Next we counted our money, $67.29 total, including $10.00 in change loaned by the PTO. Several girls then straightened up the display case so that everything would be ready for business the following week.

Later that afternoon the entire group met together. I put the inventory sheet on the overhead projector so that we could work together to figure out the sales tax and evaluate our sales for the first week. We multiplied the quantity sold of each item by the sales price of the item and then added all the subtotals to determine our total store sales for the week. When we compared this total with the money taken in, we were $20.00 short!

The students really panicked (not to mention the teachers). We immediately tried to find what went wrong, and we discovered that on the day we had transferred the newly arrived supplies to the display case, there were so many activities going on at one time that the students forgot to check the invoice against the order received. Sure enough, after poking around, we found that only half the packages of paper were delivered. Also in the process of the search, we found a mistake on the invoice--a $4.80 error that was not in our favor.

chart Smith

Ball Pens sales					
3/2	ball	pens	63	15¢	9.45
2/23	"	"	10	19¢	1.90
2/16	ball	pens	40	19¢	7.60
2/9	"	"	40	19¢	760
2/2	ball	pens	20	19¢	3.80
1/26	"	"	47	19¢	8.93
1/18	ball	pens	47	19¢	8.93

Figure C2-8

	Our cost	Sell
folders	.14	.20
felt pens	.20	.29
paper	.21	.29
notebooks	.68	.99
rulers	.07	.10
erasers	.12	.15
scissors.	.16	.19
pencils	.05	.09
Ball pens	.09	.19
spiral notebooks	.34	49
crayons 8pack	.13	.19
crayons 24pack	.31	.45
scissors	.27	.39

122

Figure C2-9

Everyone was naturally relieved to find that our money was only 65¢ short. We figured that part of this discrepancy could be attributed to the sale of pencils. Since they were priced at one for 9¢ and two for 15¢, it was too difficult to figure our exact revenue from pencils, based on the number sold.

* * * * * * *

After the store had been operating for about a month, one of the students asked if we could see how our sales were going. We took a look at the weekly inventories and found that the sales had dropped about 50% during the past two weeks. I asked the students why they thought this had happened.

"The new is worn out."

"We're out of some items."

"They're not as excited as they were before."

One of the boys said jokingly, "Maybe we could have a sale." The other students picked up on his idea right away, although a few were afraid we would lose money.

Someone mentioned that pens would be a good sale item because we would soon be receiving a new shipment of striped ones and then everyone would buy those. We worked together to figure the cost of our "old" pens which we purchased in large boxes--forty-eight pens for the price of thirty-six. The students discovered that with our 30% discount from the supplier, we were paying only 9¢ apiece and charging 19¢. The group voted to lower the price to 15¢, still a good profit, and run the sale during the next week.

Our sale on pens was extremely successful. The number of pens sold during a one-week period reached a record high and even with the price lowered by four cents, generated more income that that received during any other previous week of business. A meager turnover of only ten pens the week before jumped to sixty-three pens during the week of our sale (see Figure C2-8).

The success of our pen sale prompted the students to assess the profit on other items whose prices could also be reduced. The only difficult calculation for the students was taking 30% off the list price to determine our wholesale cost. Eventually, we compiled all the data we needed and the students made bar graphs showing our profit on various items (see Figures C2-9 and C2-10).

Later in the year a group was formed in response to customer complaints about the high price of pencils sold in the school store. This led to a discussion of prices at differ-

ent stores and then to the topic of cost versus quality. We were suddenly into the Consumer Research unit. The students actually built unbiased apparatus for testing our pencils. Their conclusion, that the qualities of various pencils were so similar that the price was the most important factor, convinced our classes to shop around for a lower-priced wholesaler.

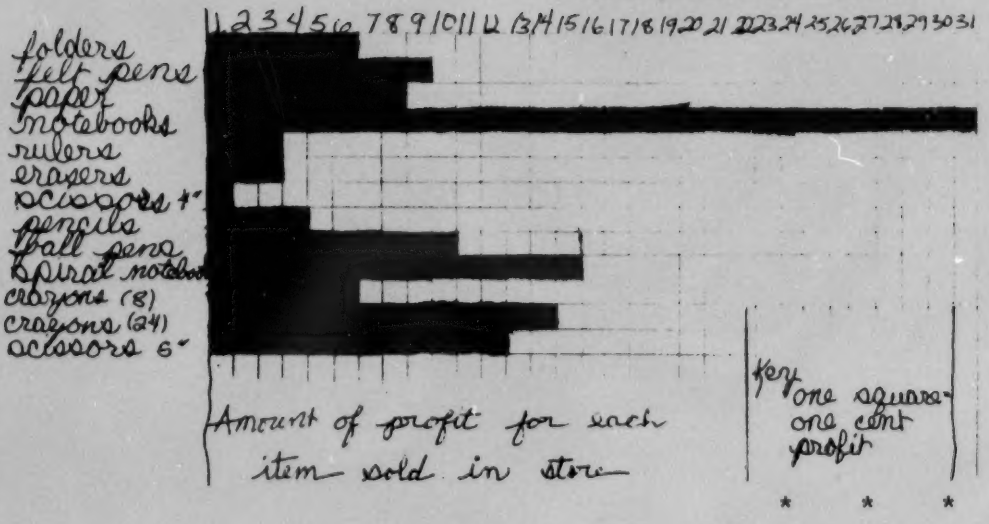

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
folders
felt pens
paper
notebooks
rulers
erasers
scissors 7"
pencils
ball pens
spiral note
crayons (8)
crayons (24)
scissors 6"
Amount of profit for each item sold in store
key one square one cent profit
* * * * * * *

Figure C2-10

Near the end of the school year we met in a large group to consider plans for closing the store. The students felt that the store should be continued by our two fifth-grade classes next year, but they decided that they would manage the store during the four-day registration period before classes began. During these four days they earned $35.00 profit from $172.00 gross sales.

On the first day of school, then, the store was turned over to the two new classes. From there the progress was slow. The new students knew so little about the store and their ideas seemed limited. It really made us realize how much the first students had learned.

Our business was dragging and our orders were taking too long to be filled. While one group of students tackled the problem of finding a new supplier, the other students discussed ways to revitalize our sales. Although some students felt that we should do more advertising, the majority felt that they were adequately covering this area.

One girl mentioned that she knew of another school store that sold items made by students, and she added, "Couldn't

we do that?" Everyone thought it was a great idea, and their suggestions came in fast and furious. Eventually, we decided to make knapsacks containing an emblem of the school mascot. There we were into the Manufacturing unit!

* * * * * * *

As the second year drew to a close, we teachers began evaluating the store and looking ahead to the next year. We both felt strongly that the first year's students, who had had to plug through the challenge in its entirety, gained the most from their experiences with the store. We feared that simply handing over the store to a third group of students would mean that they would spend their year just learning to run the business. Therefore, we felt that the best thing would be for the store to be sold out. Luckily, another teacher was interested in sponsoring the store (see log by John Limon). We were delighted since that would assure a fresh approach and allow us to bow out still "lovin' it."

We explained what would be happening to the store and asked the students to decide how they wanted to handle the closing. They were concerned about many things (e.g., "Do we give everything to them?" "What about the display case?"). In the end, they decided to sell out everything and to use their profits to buy a glass display case for the new store.

As we had about four more weeks of school, some of the students organized a Closing Out/Going-Out-of-Business Sale. They cut all prices by 20% and advertised by intercom announcements, notes, and posters. The sale lasted for two weeks.

In the meantime, the other students organized the final event, auctioning off the remaining supplies. To prevent the 800 students at school from yelling out many bids at once, the group devised a numbers method and signs to hold up for bids. Prior to the auction, all the classes in school were given an opportunity to have a team of our students demonstrate how the bidding procedure would be conducted. The students also made explanatory flyers that asked parents to practice with their children at home.

On the day of the acution, approximately half the student body, carrying their numbers, came to the gym. Our student auctioneer, who had been selected by our classes as the best in the auditions, then began. Much to our surprise, things really went very smoothly, and we sold everything. Many items were sold at the regular price (we stopped the bidding

there), but some bargains made the bidders happy. After the auction, we spent the rest of the day delivering goods and collecting money.

Once we were out of business, we paid off all debts and taxes. With our profits we purchased a new glass display case for the next school store, and we even had enough money to buy a complete potter's wheel for the school. The students were really thrilled to be able to do something that significant for the school. It was a very good two years for all of us.

At Heatherwood

Students Turn Salesmen

The "grand opening" of the Heatherwood school store will be Monday morning, at 8:15, when fifth grade students of Mrs. Margaret Hartzler and Mrs. Kathleen Schultz put their inventory of school supplies up for sale to the student body.

Pencils, notebooks, paper, and rulers will be among the items to be sold at first, and, eventually, the students plan to add a variety of items in school colors, red, white, and blue, and bearing the name of the school mascot, "Heatherwood Herons." Currently, all students are competing in a contest to select an illustration of the "hero," also to be printed on items such as sweatshirts and pencils.

Recently, the fifth graders have been advertising the store with posters, ditto'ed announcements, intercom and video-tape advertising. They have support of the school's PTA, which funded the project in the amount of $100, and they built their own showcase for display of the sale items.

Store hours will be from 8:30 to 8:55 a.m., Mondays and Fridays, and 12:25 to 1 p.m., on Wednesdays.

YOUNG BOULDER

STOREMINDERS — From left, fifth graders Kenny Brown, Paul Dohrmann, Janice Cavanagh, and Karen Tesitor display some of the items they'll soon sell in Heatherwood Elementary's school store.

3. LOG ON SCHOOL SUPPLIES

by John Limon*
Heatherwood School, Grade 6
Boulder, Colorado
(August 1974-June 1975)

ABSTRACT

This class of sixth graders at Heatherwood School, Boulder, Colorado, spent an average of two and a half hours per week working on two phases of the School Supplies Challenge. First, the students reorganized a defunct school store previously sponsored by two fifth-grade classes. To raise funds for purchasing their basic inventory, the class sponsored a garage sale from which they earned just over $100.00. The students then formed four groups to plan for the opening of the store. While the Survey Group devised and conducted a survey of the student body to determine the most popular supplies, the Advertising Group developed a trademark (a footprint) with which other students would associate their slogan, "It's Coming!" The Security Group devised a locking system to protect the school store display case, and the Catalog Group priced and ordered the most popular items on the survey. During the Grand Opening of the store, the class gave out balloons containing discount coupons and held a drawing for a prize. The class later formed new committees (Finance Board, Catalog/Ordering, New Products, and Consumer Relations) which managed the store for the remainder of the year. During February the students decided to expand their store operation by including a recycling bin for storing reusable supplies for free use by students and teachers. One group of students visited primary classes to determine the most frequently used items that could be collected by the class. Groups were formed to scrounge items from local industries. Although a bin was designed and construction was started the school year ended before the students could implement their plans.

Shortly after the fall term began, the topic of a school store arose during a class discussion. Some of my students had previously helped with the operation of a now defunct school store which had been sponsored by two fifth-grade classes. Because our school is located in a residential area and is rather isolated from businesses, the students really felt the absence of a school store from which they could readily obtain needed supplies.

*Edited by USMES staff

After the students decided to reestablish the school store, their first concern was raising money to grubstake a basic inventory. The previous store had been initially opened with a $100 loan from the Parent-Teacher Organization (PTO). We considered this as one possible source, but we felt that we should also investigate other financial routes. The students were quite animated during our discussion as they brainstormed the following money-making ideas:

1. walk-a-thon or bike-a-thon
2. car wash
3. another PTO loan
4. garage sale
5. bake sale
6. pony rides
7. carnival
8. mowing lawns and other odd jobs
9. selling golf balls (scrounged from the nearby golf course)

Some ideas were quickly rejected; e.g., pony rides could involve legal hassles; no water supply was readily available for a car wash. The idea of a carnival was good, they thought, but it would compete with various Muscular Dystrophy carnivals in the neighborhood. The period ended with a class consensus that garage sales were really popular and would be good since many students had recently helped their families with sales. After a quick vote, the class decided to aim for a garage sale as their way of raising capital.

For the next three weeks all our attention was focused on the garage sale and a simultaneous bake sale. I had first thought that staging the two events at once might be attempting too much, but the students' arguments convinced me it could be done. The class devised ads for the intercom, school bulletin, and local newspaper (see Figure C3-1), made a videotape ad for other classes, wrote letters to parents, and made signs and posters for the school. The principal gave us permission to hold the sale on the school grounds but not to use the buildings. The students prepared a schedule of workers and made arrangements for pricing and displaying the items which were donated by class members.

On the Saturday of the sale, we were really surprised that prospective customers began to arrive even before our opening hour. The baked goods sold out quickly, just as the students had predicted. Even though it was a cold, misty day for an outdoor sale, people really flooded in for the first couple hours.

"LET'S make a deal." "The price is right." Super fantastic garage and bake sale. Help 6th graders raise money for school store. 75th Street to Heatherwood Drive. Follow signs to Heatherwood School. 7750 Concord Drive. 10:00 a.m.-5:00 p.m. Saturday.

Figure C3-1

The students were marvelous and really in charge of everything. Because it was the most popular job, the cashiers rotated every half hour to give everyone a chance to work. As the tables became bare, the students quickly restocked them with books, toys, clothing, and shoes. The class popcorn makers worked tirelessly to keep up with the demand. At the end of the day, we divided up the remaining goods that were worth keeping, and the students began the clean-up chores. Finally, we counted the money, a total of $111.90! Subtracting our change money and the cost for the newspaper ad, we had made a profit of $102.90. I was very exhausted and pleased, in that order.

When the class met on Monday, we reviewed the sale for those people who had been unable to attend. Even the students were surprised that the baked goods had been such runaway best sellers. They had had no idea that people would buy an entire cake when it had been cut into squares, each marked 5¢. One of the most efficient setups had been the change table. One boy had brought two tackle boxes which had been great for keeping the coins separated. As we had surpassed our goal of making $100, there was a smile on every face.

Because all our funds were in cash, we discussed where we should keep the money until we purchased the supplies. After various safe places were suggested, the class decided that we should open a bank account. They felt that paying our bills by check would both provide a record of our expenses and be safer than sending cash through the mail. I later opened a separate account for the store in my name, and the students took care of all the check writing except for the signature.

With our financial backing established, we started planning the actual "nuts-and-bolts" setup of the school store. One of our initial tasks was choosing the items we would sell. The students first called out various supplies until someone suggested making a list on the board and separating the items into categories. The students who had worked in the previous school store helped us figure out the following classifications:

<u>Hot Stuff</u> (good sellers)

"Heatherwood" pencils (specially printed)
"Heatherwood" pens
"Heatherwood" folders
"Heatherwood" backpacks
felt-tip pens primary pencils

Moderate Sellers	Poor Sellers
crayons	scissors
paper	"Heatherwood" buttons
erasers	pencil cases
plain pencils	
rulers	
spiral notebooks	

My students felt that the experiences of the previous store would help them set up their store, but they definitely decided not to have a "repeat performance." They agreed that many new items could be added to the store inventory, and the compiled their suggestions into the following list:

stapler and staples	tape
"Heatherwood" flag/pennant	paper clips
school stickers	mechanical pencils
Big Chief notebooks	paperback books
hole punchers	tiny pencil sharpeners
plastic notebook covers	patches

When the lists had been completed, we discussed how to select the items for the store inventory. The class decided that it would be best to ask our potential customers for their opinions. Therefore, our next task was to devise a survey for the students in other classes.

At our next USMES session, the students decided they could best handle the preparations for opening our store by working in separate groups, each in charge of one specific area: surveying, advertising, security, and ordering supplies. The activities of these groups are described in the following paragraphs.

Items — Check 5 items that you would like to have in the School Store

1. Staplers and Staples ✓
2. Heatherwood flag or penant ✓
3. Heatherwood stickers ✓
4. Big chief tablet
5. pencil cases
6. Hole punchers
7. rings for repairing
8. cheaper buttons
9. plastic covers
10. Tape
11. paper clips
12. Mech. pencils and lead
13. paper back books
14. tiny pencil sharpeners
15. Heatherwood patches ✓

Figure C3-2

Survey Group

The Survey Group used the lists of items generated by the class to devise a questionnaire for all students in grades four, five, and six. They reasoned that the older students would probably have more need for the supplies, plus more money to spend, and they felt that the younger students might have difficulty reading the survey form. Fifteen items were listed from which the surveyed students were to select five that they wanted the store to keep in stock (see Figure C3-2).

Because approximately 300 questionnaires were needed, the group made three identical dittos, just in case one or

two dittos wouldn't clearly reproduce such a large quantity. A schedule was also made for distributing the surveys. When the students had collected and tallied the responses, they reported their information to the class.

Advertising Group

The Advertising Group was to develop a campaign promoting the "Grand Opening" of our store. As their preliminary ideas seemed to focus on standard methods of advertising (e.g., posters and intercom announcements), we held a general class brainstorming session to help them think of catchy gimmicks.

I related a story of a very successful advertising campaign for coffee that had been conducted when I was growing up in Chicago. For several weeks the ads simply stated, "I will bring a mountain to Chicago." Gradually, the ads became more specific, untimately announcing the brand name of the coffee. The students felt that the element of suspense engendered by the coffee company was very successful. We batted around many ideas for our store ads; some had merit and some were too obvious, for example, posters reading "The School Store will be here soon."

Several days later we continued our discussion on advertising, and some good ideas started to emerge. The class decided that they, too, needed an element of suspense for their ads. When one student suggested the motto, "It's Coming!" as a phrase that might work, the other students immediately supported the idea.

The discussion then turned to an idea for a trademark. I suggested that perhaps they could think of a symbol so that people would associate the statement "It's Coming!" with the idea that the school store would be opening soon. After further discussion, one student suggested drawing a footprint with our motto written inside.

The Advertising Group then spent several sessions working independently to develop a prototype for the trademark and to make posters. They first deliberated the kind of footprint they would use. One suggestion was to have it resemble a shoe's impression. Another suggestion was a bare foot; the girl actually traced her foot for a pattern. Another choice was a sort of abominable snowman type of print. This last idea proved to be the most popular, and our trademark was thus decided.

The group next started work on their advertising signs. They decided that various sizes of the footprint were needed, but they should all look alike, i.e., be to scale. They also thought that the school store workers should wear

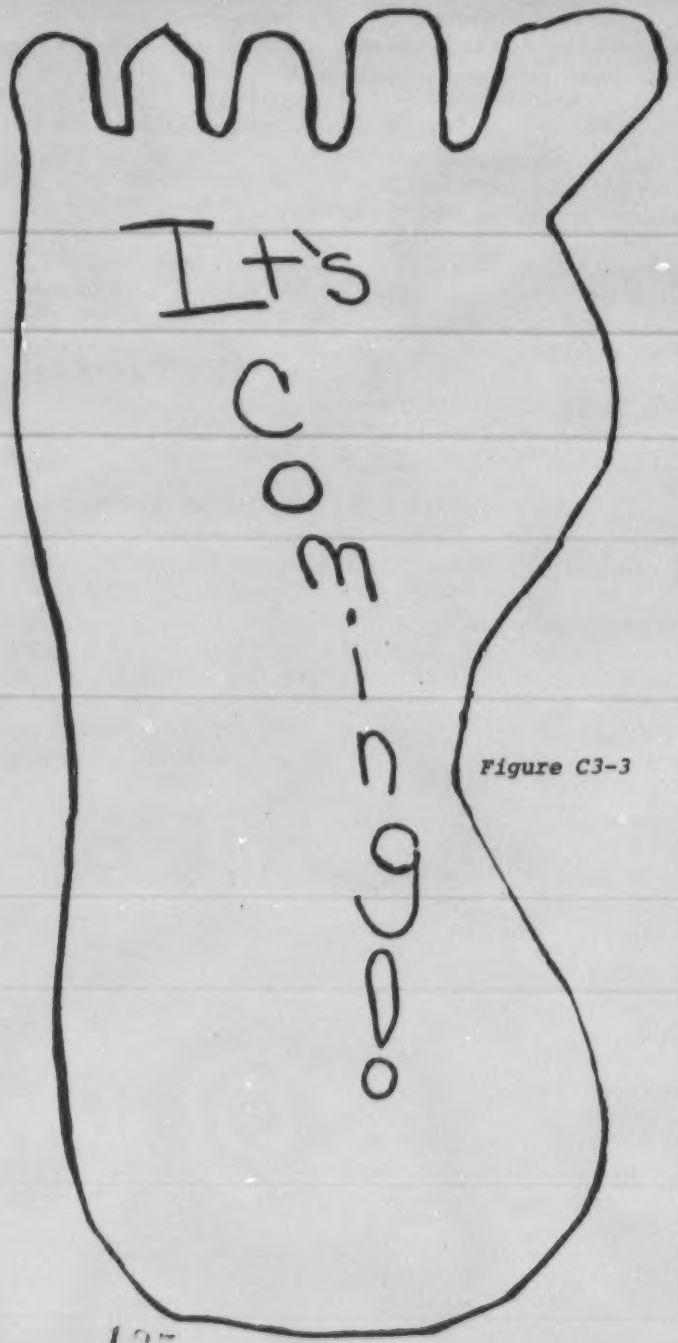


Figure C3-3

small "feet". To make multiple copies, they drew patterns on a ditto master and duplicated them (see Figure C3-3).

The group spent one entire session industriously cutting out footprints of all sizes. They also made a schedule so that they could systematically cover each area of the school with signs and with footprint drawings on the blackboards while the classes were out of their rooms. On each footprint the students wrote "It's Coming!" Two of the boys also made a very large sign about eight feet long, containing a huge footprint and our motto. This we called the "sudden sign" because it was to be used by students who would suddenly race across the playground with it during recess.

When the Advertising Group began displaying their signs, they were very pleased to hear other students and even some teachers asking, "What's coming?" That was the sort of interest we were trying to generate.

Security Group

This group was to design a security system so that the supplies could be locked up in the display case. (We were fortunate to inherit two very nice glass display cases purchased by the previous school store from a local grocery store that was closing its bakery department.) The members of the Security Group had quite a bit of difficulty getting organized and deciding whether or not they wanted to construct a burglar alarm for the display case.

Of all the groups, the students in the Security Group were the most diverse in their abilities. Two boys in particular were several grades behind in their basic skills, but they especially enjoyed the USMES sessions. Not only did they like talking and moving about, but also they felt successful in what they were doing. Working with each other and the other group members had a good effect on them. They were forced to listen and to evaluate the ideas of others; they were forced to compromise and to interact. It wasn't always easy for them (or me), but they certainly learned some of the social skills of dealing with other people.

Some of the initial ideas of the group were rather elaborate, e.g., obtain a pinball machine tilt switch that would set off a bell if the case were jarred or moved. One boy even mentioned a light beam setup similar to museum security devices. After many delays, they finally managed to finish designing and installing a padlock which was mounted so that it closed over the screws fastening it to the door frame. They also placed a long rod of wood inside the sliding door to prevent it from being opened.

When the lock had been installed, the Security Group was

satisfied that their system would foil any burglary attempts. Their device was put to a real test in late February. One of the students rushed into class and excitedly told how someone had broken into the school store the previous evening. He related that during the basketball game some third and fifth graders had been seen looking through the display case. Naturally, the news was a big shock to all of us; we couldn't believe that our locking system had been breached. As we questioned the boy, we learned that most of his story was hearsay. I later talked with the two boys who had been identified, and it turned out that although they had tried to open the store case, the lock had prevented entry. They did get into an open bin under the case, but it contained only empty boxes. This was the extent of the reported "break-in." We were all pleased that the lock had withstood the amateur burglary attempt.

Catalog Group

In the meantime, the Catalog Group had been busily looking through various catalogs to check on prices and availability of possible items to order. Initially they had been very enthusiastic about ordering either small footballs or pennants printed with the school name. However, when they read the small print in the ordering details, they discovered that they would have to order in quantities of 1000 which meant a cost of approximately $70. This information quickly cooled their enthusiasm since they knew we had only $102 in the bank. They decided to return to the survey results and to order the most popular items from the survey.

By mid-October the catalog used by the previous school store group finally arrived. My students started looking through it right away and soon ran into trouble when they tried to figure out the terminology.

			List Price/Each	Price/Doz.	
	Pkg.	Case		Pkg.	Case
Glue	1	4	29¢	$2.09	$2.00

We had a quick conference with the teacher who had previously worked with the school store group, and she explained: one package contained one dozen items and one case contained four dozen items.

The group then did some quick calculations on the board to find how much money they could save if they purchased glue by the case. They discussed whether it would be worth

investing $8 in glue in order to save 9¢ per dozen. They finally decided that because glue was not a quick seller, it would tie up too much of their money. The group then reviewed their list of items to find which fast sellers could be purchased by the case. Using a pocket calculator, they made preliminary calculations for a total order.

At their next meeting the Catalog Group made an extensive list of all the items they might order including products previously sold in the school store and new items that had been popular on the survey (e.g., binder organizers, jumbo crayons for kindergarten children, mechanical pencils, stapler kits, and both wide-ruled and collegiate-ruled filler paper). When the students added their order, the total cost was over $136. They decided that the entire class should make the decisions about what to order and in what quantities.

When we met for a class discussion, the Catalog Group reported their findings. According to the former teacher sponsoring the store, we could order supplies and then pay after a thirty-day billing period. It took quite a while for most of the students to understand or even to approve of this plan; they felt we should pay as we go. When the Catalog Group explained that our entire order would probably cost nearly $150, the class was in an uproar. The students demanded an immediate accounting of expenditures. The Catalog Group then led a discussion of what they had learned about wholesale and retail prices, and the students constantly compared the price of each item to those at a local supermarket (which they all wanted to undersell). By the end of the period everyone agreed that we should send in our order without money but then pay as soon after we were billed as we could.

The next day the entire class again met to determine which items we would order. After much discussion, the students decided the following supplies should form our basic store inventory:

binder organizers
erasers
jumbo and regular crayons
mechanical pencils and lead refills
filler paper (wide-ruled and collegiate-ruled)
scissors
staplers, staples
ballpoint pens
regular pencils

Because the minimum order for pennants was $33, we decided

to table this idea for a while and to assess our financial situation after the school store had begun operation.

The Catalog Group telephoned our order to the supply company, and the shipment arrived three days later. Since we were all eager to examine the supplies, we opened the boxes immediately. The students were very impressed with the quality of the supplies. They especially liked the organizers which were all different; some had various colored leather motifs, and others had photographs of football action or a seashell or a flower. Everyone started selecting a favorite one, and the room was filled with cries of "I want this one."

As we were examining the merchandise, we discovered that some "fine" lead had been mistakenly ordered as refills for the mechanical pencils. The girl who had called in the order was really distressed because this lead cost $21. She was relieved to find out that we would get a refund on our next order when we returned the lead to the supply company. This was the first time she had heard about a bill being credited for the amount of returned items.

When the excitement had somewhat subsided, the Advertising Committee reported to the class on their latest plans. They had made a huge sign saying "Grand Opening" which was to be used with red, white, and blue crepe paper ribbons extending from the ceiling to the store counter top. One of their cleverest gimmicks was an idea for discount coupons. They had placed small pieces of paper (some blank, other reading "5¢ off" or "10¢ off") inside balloons which they distributed to every fifth, seventh, and eighth child in line at the Grand Opening. Their third plan was to hold a raffle with a mechanical pencil as the prize. They used a ditto master to make entry blanks with spaces for a child's name, grade, and teacher. Two of the girls decorated a box with red and white crepe paper and printed "Entry Box" on the front and "Deposit Here" by a slot in the side.

We next discussed which days we would hold our Grand Opening for the approximately 750 students in our school. Because the following Thursday through Tuesday were parent conference days, the students would be dismissed at 11:30 A.M. each day. The class decided that for those four days all the classes could be invited to come to the store on a daily schedule from 11:00-11:30. Three boys who had been in the Security Group made out the time list for each class and then visited the teachers to make final plans with them. We spent the rest of this session blowing up balloons and completing the "feet" buttons while the Grand

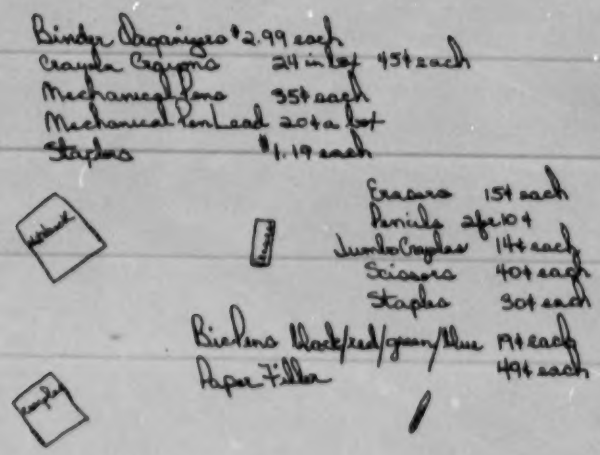

Binder Organizers $2.99 each
Crayola Crayons 24 in box 45¢ each
Mechanical Pens 35¢ each
Mechanical Pen Lead 20¢ a box
Staplers $1.19 each
Erasers 15¢ each
Pencils 2 for 10¢
Jumbo Crayolas 14¢ each
Scissors 40¢ each
Staples 30¢ each
Binders Black/red/green/blue 99¢ each
Paper Filler 49¢ each

Figure C3-4

Opening Committee decorated the lobby.

The final day before our Grand Opening was one of busy preparation. We determined our sales prices by quickly looking up the list price of each item, then comparing it to the suggested retail price, and finally choosing an amount between the two. For example, the mechanical pencils had a suggested retail price of 39¢ which was a 40% markup over wholesale price. The students thought that this was too high and decided to charge 35¢. No definite profit margin was established; the students reviewed and priced each item separately. The entire class worked together on only a few prices because the Catalog Group felt that since they had done all the work of searching through catalogs, determining how much we could buy, and actually phoning in the order, they had earned the right to price the items. They decided to post prices on a large poster which would be clearly visible to customers as they waited in line to purchase their supplies. (See Figure C3-4 for facsimilie of poster.)

From the experience of the previous store, we knew that we would have to charge sales tax on all purchases. Three students made a tax chart for our cashiers to use. The chart, based on a state form, contained two columns, one for the amount of sale and one for 3½% of the amount that had to be added to the total sales price. (See Figure C3-5.)

We solved the problem of deciding who would work as store cashiers by using a number guessing game. I wrote a number between 1 and 100 on a scrap paper, and each student then had one chance to guess the number. The person guessing the closest number, either above or below, became a store clerk. This seemed to eliminate all squabbling about who would be paired as a clerk with whom and during which shift of six students they would work.

The day of the Grand Opening of our new Heatherwood School Store arrived. Last minute details were taken care of just seconds before our first customers visited the store. Most final preparations were small, such as cleaning the glass on the store case so that the display would show up. The janitor also helped us relocate a screw, which hadn't been mounted flush by the Security Group, thereby avoiding a skinned knuckle for us. Our most pressing detail was finding money to use as change in our store. We were all very chagrined when we discovered our oversight. Fortunately, however, the class aide, who was also the lunchroom cashier, came to our rescue. The students wrote out their first check for $5 and put the needed silver in the cashbox.

Sales Tax

Amount of Sale			3½%
.01	thru	.18	.00
.19	thru	.51	.01
.52	thru	.84	.02
.85	thru	1.17	.03
1.18	thru	1.51	.05
1.42	thru	1.84	.05
1.85	thru	2.16	.07
2.19	thru	2.51	.08
2.52	thru	2.84	.09
2.85	thru	3.18	.10
3.19	thru	3.51	.12
3.52	thru	3.84	.13
3.85	thru	4.18	.14
4.19	thru	4.51	.15
4.52	thru	4.84	.16
4.85	thru	5.18	.17
5.19	thru	5.51	.19
5.52	thru	5.84	.20
5.85	thru	6.18	.21
6.19	thru	6.51	.22
6.52	thru	6.84	.23
6.85	thru	7.18	.24
			.25

Figure C3-5

The display case was located in the school lobby with huge footprints saying "It's Here!" leading up to it. My students had placed three strips of masking tape on the floor to form two lines leading to the store counter so that customers wouldn't crowd around all at once. As they reached the display counter, they were given an opportunity to look over the items, ask questions, and make purchases.

The store cashiers were very cooperative with the customers, and they also kept a check on each other's work. One boy was reprimanded by the group because he had been charging 1¢ tax for sales of 52¢ rather than 2¢ tax. Another student let him know that he was throwing away the class's profits. After this incident all the clerks agreed to check the sales tax guide before quoting a total sales price.

Advertisements had encouraged students to visit the store even if they had little or no money to spend because they might still receive a balloon with a discount coupon. However, only those students who made purchases were eligible for the raffle. Most customers purchased at least one item, and by the end of our Grand Opening, the store clerks noted that we would soon have to reorder certain supplies, especially mechanical pencils and lead refills, which were nearly depleted.*

After our successful Grand Opening days had been completed, we met in a large group to discuss the business hours and the working schedule for the school store. The suggestions ranged from "open every other day" to "open only in the mornings before school." The consensus of the group gradually gravitated toward being open every day, both before school and during lunch. The hours established were 8:00 A.M. to 8:30 A.M. and 12:40 P.M. to 1:10 P.M. Because of the size of our student body, the lunch hours were staggered, and our store schedule at lunchtime would accommodate only third through sixth graders. The class decided that other students could arrange to visit the store during the morning hours.

Each student then selected a working partner, and a list was made of every two-person team. The class decided that the bus riders would work at lunch time and the walkers in the morning. This system gave everyone a chance to work as a clerk. We also briefly discussed some students' confusion about when they were supposed to work, and decided that a posted calendar of schedules would help everyone remember.

*The students might keep records on sales each day. This could be done graphically. See A Composite Log.--ED.

Several days later we reviewed the operation of the store, and I mentioned a problem I had noticed. One day after school I had found the display case unlocked. The reason, I later discovered, was that several of the students had not understood how to place the wooden rod correctly in the door (i.e., if placed on the edge rather than the flat side, the door could still be opened). I had also noticed that one crew of workers failed to lock up a box of pens when they had departed for the day. So, carelessness was a problem, and to counteract it, I found that I had constantly to remind the workers to check everything. Many of the students had never before had to accept this type of responsibility, and even though I felt that I was sometimes nagging, they did seem to feel that my reminders were helpful.

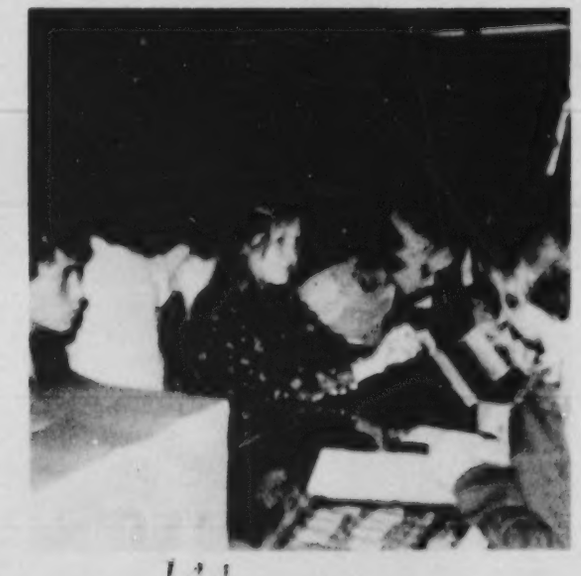
As the operation of our school store continued, we found that the management was becoming too complicated when we had to work out all details with the entire class. Consequently the students decided to divide the areas of concern into smaller groups, each in charge of specific responsibilities. The following committees were formed:

1. Finance Board--keeping ledgers, determining order costs, writing checks, paying bills

2. Catalog/Ordering Committee--keeping inventory and determining quantities of supplies to order

3. New Products Committee--looking through additional catalogs and making recommendations for new items to order

4. Consumer Relations Board--dealing with customers who purchased a defective product or who were disappointed that a purchase was not what they had expected



The Finance Board members and I ate lunch together that day, and we discussed how to fill out the various tax forms and write checks correctly. They could hardly wait to pay the bills!

The Consumer Relations Board originated because of a malfunctioning stapler that had been returned by a customer. This group was also to be in charge of writing occasional ads as they were needed.

Later in November when all the student body had had ample opportunities to make purchases at our store, we held our

raffle for the mechanical pencil and lead refill pack. A third-grade boy won, and, naturally, when I made a big deal about handing over the prize, he remarked that he had just bought a mechanical pencil. (Isn't that just the way it always is--the guy who already owns a Cadillac wins another one at a raffle.)

Several days later the class became involved in a heated debate over our store prices. Some students wanted to lower prices because they felt the store shouldn't be a "rip-off." They wanted the store to make a profit, but they also wanted other students to think of it as a service, too.

To resolve the issue of overcharging, we decided to calculate the percentage of profit on several items. The students decided that they wanted to lower the prices on staplers and erasers. A profit of 3¢ was okay for erasers (wholesale price 12¢, retail price 15¢) they thought, but a 25% profit was excessive. They were really shocked when they discovered that the 25% profit was 3¢. Prices were also lowered for mechanical pencils, paper, and felt-tip pens. This led to a discussion of how most businesses have "overhead" and "labor" charges that must be figured in the sales price.

The topics of sales prices and profit arose again when the New Products Committee reported to the class on their research. They suggested the following new items for the class to consider adding to our inventory:

pennants	rulers
tiny footballs	school glue
spiral notebooks	bumper stickers
Glo-balls	protractors
small tissue packs	compasses
paperback books	campaign-type buttons

After discussing various pros and cons, including the cost of each item, the class agreed to add compasses, rulers, school glue, and protractors. I was rather surprised but also pleased when the students insisted that the rulers include a metric side.

With the items selected, we decided that the entire class should work together to determine the sales prices. We calculated more profit percentages for the items that we were already selling, and we continued to find large discrepancies. Several students felt that we should do all we could to make money, but others insisted that the school store was a service. Although some heated discussions took place, a compromise was finally reached between the two groups, and

the new items were priced at a moderate percentage above cost. The students then voted to adopt a variable price structure for pricing all new items individually instead of imposing a flat percentage of profit.

The students continued to restock the store inventory whenever the display case started to look bare as our orders were filled within only two days. They noticed right away that the supply company from which they purchased supplies always sent a total cumulative invoice of all their orders with each new order. Rather than keeping a separate inventory of supplies received, they used the company's invoice which detailed item amounts, catalog ordering number, price per dozen, etc.*

When each new shipment arrived, the students again bickered over their retail prices and spent a lot of time soul-searching for fair prices. Many times cries of "Unfair!" and "Too high!" would permeate our discussions on pricing. The minority of capitalists were always outvoted, and, in fact, most of the children really began to view the store as a service for both themselves and their fellow students rather than a money-making endeavor.

Sales were good all year, with the exception of scissors and jumbo crayons. Prices of many items were actually clobbered by inflation, in particular, paper, pencils, and felt-tip pens. Nevertheless, the students held the line on the retail prices and consequently, didn't realize any great profits.

After our initial advertising campaign for the Grand Opening, we never needed to advertise formally again. The "word-of-mouth" messages spread the news of any new items or price changes with incredible speed. Our most popular item remained the mechanical pencils, and when we received a new shipment, the word went out like wildfire. Within two days, frequently less, they were all sold out.

Although we had posted a schedule of working hours, many students had been failing to check it. For several mornings customers had arrived but the clerks hadn't. Because the school store was so popular, we were receiving loud complaints from customers who were not being served. After considering various solutions to our absentee problem, the students decided to give a reward or bonus of a 35¢ school store gift certificate to the best team of clerks for the month. We agreed to use a large calendar to keep track of the attendance records for workers. Our plan worked so well

*See A Composite Log for a graphical method of keeping records of sales.--ED.

that after two months we were able to discontinue the surveillance.

The December vacation and other school activities interrupted our work on the School Supplies unit until the latter part of January. Other students complained constantly until we were able to reopen the school store.

One interesting thing did result from our temporary closing. We received several notices about paying taxes and finally a notice to appear in the state tax office. I accompanied six children on the visit to the taxman who was very kind and explained several details to us. It seemed that even though we had not been open for business from mid-December to the end of January, we were still required to file a tax form. The students, who had thought we were going to be part of a big court scene, were a little crestfallen, but, I believe, more aware of the real world and how day-to-day government functions.

* * * * * * *

Recycling

Just before the December vacation the class had become involved in a discussion of recycling when I brought in a booklet illustrating how new items can be made from discarded materials. Throughout several sessions of discussions, the students decided that there were several reasons for recycling: (1) to make money, (2) to clean up the environment, and (3) to use discarded materials for making another item. They also formulated a definition of recycling, "using something over again."

During our discussions one girl suggested that we could also use the school store as a center for collecting and dispensing items. She added that maybe the class could use the collected materials to make new things to sell. Another student agreed with her idea and suggested an incentive program for collecting that would entitle a child who brought in reusable materials to receive a free item from those already collected.

When, in January, we resumed our discussion of reusing discarded items, we applied our thoughts to the question, "Can we do anything about recycling materials for our school?" We thought that recycling was perhaps not obvious to most people and, therefore, neither to us. We talked about concrete suggestions, such as collecting old pencils, and then considered consulting various local industries that might donate scrap items.

We talked about how we would approach the various indus-

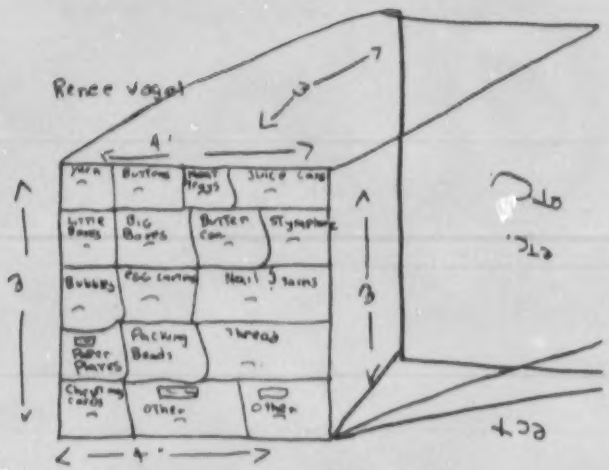


Figure C3-6

Leanne De Waard March 6, 1975

Usmes

Materials: Wood, saw, nails, hammer

Figure C3-7

tries, and then we realized that we should first have an idea of the sort of items that were needed. We thought that the lower grades would probably have more use for the discarded materials, but we didn't have any facts on which to base our opinion. Someone proposed checking with the first graders, and I then suggested that the students would probably obtain more information if a small group actually spent a day monitoring activities in a first-grade class. We set up a lottery drawing to choose our eight "exchange" students.

Later the selected students reported to the class that the primary students had used paper plates, toothpicks, computer cards, newsprint, and tissue paper. One group interviewed a primary teacher and obtained the following list of items she could use:

cans of different sizes	nuts, bolts
newspaper	nails
old puzzles	milk cartons
old socks	sandpaper
old books, magazines	

Most of the month of March was spent designing and making models of a collection bin for storing our discarded materials. In developing the designs, the students agreed to try to incorporate several needs. For example, the container had to be readily accessible and easy to open by both teachers and students. It also needed to be divided into several sections to separate various categories of items. Some students also thought that a way of closing or securing the bin was needed so that the contents wouldn't be lost. Other students thought that the center should always be open, and their designs reflected this idea (see examples in Figures C3-6 and C3-7).

As the students completed their designs, I gave them scissors, tape, and a large piece of oaktag to use in building a model of their design. A few of the children made their models to scale but most did not. The design shown in Figure C3-8 was later chosen by secret balloting as the one we would construct.

With the design for the bin chosen, we listed on the board the students' suggestions for our future tasks:

1. actual construction of the bin
2. decorating it
3. gathering materials to distribute
4. training teachers and students how to use the bin (possible reward system)

9ft High and easy to get into has lots of compartments.

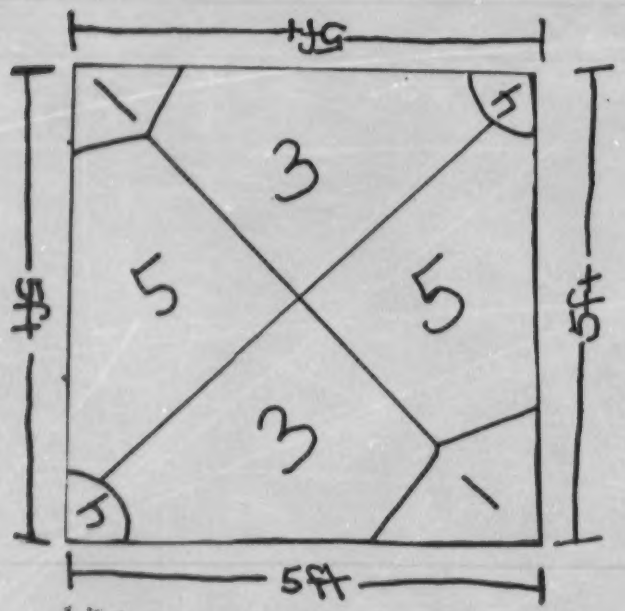


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Figure C3-8

5. contacting industries
6. parents contributing items from their place of work
7. educating parents to our goal of reusing items
8. intercom announcements

Later the students decided to work in groups, and so we categorized our tasks and delineated the various responsibilities of each group:

1. At Home Recycling--Plan a method for making each family aware of recycling and create a plan for recycling activities and a mini-recycling center at home.

2. At School Training Program--Set up a presentation to make other teachers and fellow students aware of the school recycling bin and how they could participate in its operation.

3. Industrial Involvement Group--Determine which local industries could be contacted and what scrap products we could obtain from them.

4. Construction Group--Build the collection bin using the design selected by the class.

The students selected groups in which they were most interested, and those who expressed no preferences were distributed among the four groups.

Problems in scheduling our USMES sessions seemed to plague us throughout the month of April. As a result of long delays between meetings, some of the students began to lose their impetus, and I had to "fire" them up again at each session. By the end of April, all the four groups had begun work, but it seemed obvious that our target data of May 1 would not be met.

At Home Recycling

The At Home Recycling Group first drafted an explanatory note about our recycling efforts to send home to each student's family (see Figure C3-9). They also began designing a game to increase parents' awareness of recycling. To see how well families would cooperate with us, the group conducted a trial run of their "home minicenter" made from a shoe box. (See one student's explanation in Figure C3-10.)

At home training

These notes will have to be copied and sent home, one to each family in the school:

Dear Parents

We have made a recycling center for the use of the school. We would like you to help bring in some of the things listed below:

1. orang juice cans
2. packing beads
3. styrafoam meat trays
4. egg cartons
5. yarn scraps
6. buttons
7. styrafoam
8. butter tubs
9. paper towel cores

These things will be put in the recycling center for use by the classes when ever any of it is needed.

We have put together a game that will help to remind people to bring in the things we are asking for, the instructions for making the game are with this note.....

Thank you
Mr. Simons
'74-'75 USMES class

Box experiment

effect: to make a portable at home recycling box.

purpose: To collect things at home in your box and carrie the box to school and put your collections in the recycling center

We took a shoe box & to see if it was the right size & we made a sign and set it next to the box. The sign read some thing like this Then we informed every one it was there. It took 1 week end to fill up. we think it is about the right size The next step

THINGS TO PUT IN BOX	
MEAT TRAYS	YARN
EGG CARTONS	XMAS CARDS
BUTTER TUBS	
PAPER TOWEL ROLLS	
BUTTONS	

is to get every one to make and use this box. this is the part for you to do. we thought it would be a good idea to send home a note about it. do you?

your usmes friends,

Renee Vogel &
Christy Bonnes

Figure C3-10

The group later reported that their experiment had been a great success. Their families had all participated, and, within days, the boxes were filled with the sort of items we needed: meat trays, paper towels cores, egg cartons, etc. The group felt that this proved that families could participate and help gather reusable materials.

At School Training

The At School Training Group also felt that their most serious problem was awareness. They decided to display around school large posters listing the items the recycling center could use:

old Christmas cards	styrofoam packing
buttons	juice cans
egg cartons	butter tubs
yarn	meat trays
old toys	

Another of their ideas was to make and wear buttons indicating one or two things that were needed.

This group felt that they could also help develop awareness by giving a short demonstration to teachers at a staff meeting and to students in each class. They planned to explain the purpose of our recycling box, how each class could use it, what to put in it, and how to take care of it.

More progress was made by the At School Training Group than by other groups. In addition to posters and demonstrations, the students drew up plans for a contest to encourage children to contribute items. After intercom announcements challenged classes to bring in the largest quantity of items, the group would place a small collection box in each homeroom area. At lunchtime a group member would collect and sort the items and then list everything contributed by each class. A few days later one homeroom would be declared the winner and awarded some prize, such as candy. (See one student's explanation of the contest in Figure C3-11.)

Industrial Involvement

From their very first meeting the Industrial Involvement Group encountered many difficulties, mainly because of two very dominant group members. I had so many complaints from the other students about the obnoxious behavior of these two that I finally had to step in and say a few words about respect for other people's opinions. I then gave the group a telephone book and the problems seemed to subside a little. They devised the following list of local companies

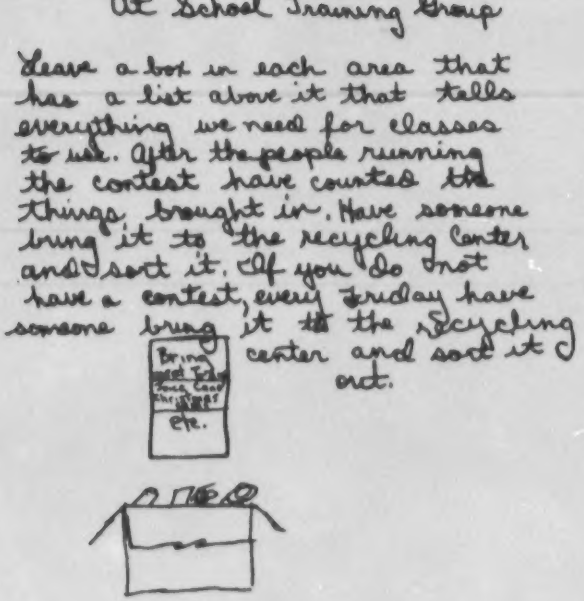

At School Training Group
Leave a box in each area that has a list above it that tells everything we need for classes to use. After the people running the contest have counted the things brought in. Have someone bring it to the recycling center and sort it. If you do not have a contest, every Friday have someone bring it to the recycling center and sort it out.
Bring
etc.

Figure C3-11

that they might call and the materials they might be able to scrounge:

local newspaper--end of paper rolls, cardboard cores, teletype paper
hardware stores--packing materials and boxes
drug stores--packing materials
liquor store--boxes and cardboard of various sizes
church--(unsure of materials)
large department stores--packing materials, shoe boxes
dry cleaners--hangers, containers
ice cream parlors--gallon ice cream containers
barber shops--bottles, containers
supermarkets--broken wooden crates
furniture stores--remnants, fabric

Bin Construction

The Construction Group, consisting of nine students with varied abilities, met in the Design Lab. I expected the boy who won the design contest to assume command, but he exhibited no real leadership qualities. The group began to flounder, and I realized that the students had no concept of how things are constructed. I cast about for examples until one boy came up with the idea of a car--the framework, the body, and the interior. This was a real start, and suddenly the discussion became quite animated as the students moved to the chalkboard to start sketching their plans.

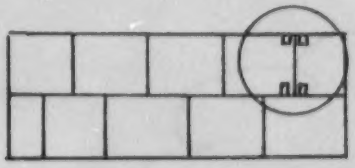
Next the students had to consider the actual size of the bin. Although his plans specified a five-foot square, the designer now said that what he had actually had in mind was a four-foot square. Then the students encountered another problem--what materials to use?

After much deliberation, they decided to use firring strips and they listed the materials they would need: ten 8-ft. firring strips (1" x 2"), two 8' x 4' plywood sheets (one 3/8" thick and one 1/4" thick).

I purchased the lumber and brought it to school. Although the students really wanted to keep the fancy curves as dividers, they acquiesed to needed modifications when they saw the limitations of the plywood.

They first started work on the bottom frame, or the chassis as they called it, after a great debate on whether or not to notch the crosspiece. As the Construction Group continued their work, internal bickering among the students slowed them down. Finally they did manage to cut the ply-

wood and glue and fasten the floor of the bin. Then, when they began to work on the interior partitions, the group greatly changed their plan to a more simplified one, similar to the following:



To make the small divider panels adjustable, the students inserted two small blocks at the top of the outside wall and two next to the inside partition, thus allowing the divider to be placed anywhere along the inside of the box. They devised this plan because it would better accommodate different amounts of materials that might be collected at any given time. The modified design also enabled the group to divide the work more efficiently. Some students cut the short blocks from firring strips, while others cut the plywood dividers, and others glued the short pieces to the sides and middle partitions. Since the construction of the new design turned out to be very time consuming, some of the students decided to work after school to finish the construction. One student even devised a design for the outside of the bin (see Figure C3-12), but there was not enough time to follow through on his idea.

Although most of the students had worked diligently, it was disappointing for all of us that the school year ended before we could implement our plans. The students did feel, however, that another class might be able to continue with their work.

* * * * * * *

As the school year drew to a close, we had to consider what to do with the school store, which had continued operation throughout the year. Toward the middle of May the students reported that the store display case was almost empty. We discussed whether we should reorder supplies for the final weeks of school, and the general opinion seemed to be that we should not. The students agreed with one boy's suggestion that, as we had only small quantities of items left, we should just give them to the fourth-grade class that would be in charge of the school store next year.

Finally the class discussed how to spend the profits from

Steve's
Plan for Painting on Box's Side

Figure C3-12

the school store. The students listed many ideas and then debated the pros and cons of each one. They very generously decided to buy an outside drinking fountain for the school and were disappointed when the principal informed us it would have to be installed through a work order and was probably too expensive. Because the fountain wasn't possible, the students decided to pass their profits along to the fourth graders so that they would have funds to order their inventory first thing in the fall.

4. LOG ON SCHOOL SUPPLIES

by Sherry Malone*
Hilsman Middle School, Grade 8
Athens, Georgia
(November 1974-June 1975)

ABSTRACT

After studying a social science topic on conservation, students in this eighth-grade class began work on a School Supplies challenge. They briefly researched the recycling efforts in their local community and then focused on organizing a school distribution center to provide teachers with reusable items that were normally discarded (e.g., plastic pill bottles, cardboard boxes, baby food jars, scrap lumber). While one group of students converted an unused closet into the storage area for their supplies, other groups talked with teachers to assess the demand for particular materials and wrote letters to local industries requesting overruns and discarded items, such as carpet ends and lumber scraps. The students also scrounged unused items from their homes and from around the school. In addition to operating the distribution center throughout the school year, the students also sponsored a successful school-wide book exchange. The class members contributed books for the basic inventory, and the other students at school then traded in their old books for new ones or purchased books for a small charge. The class donated their earnings and leftover books to the school library. Although formal USMES sessions on the School Supplies challenge were discontinued after the recycling center began operation, the students periodically discussed any problems that arose in their collection and distribution of discarded items.

I introduced the School Supplies challenge to eighth-grade students in an ungrouped social science class while we were studying the natural resources in Georgia. For three days we had focused on how the natural resources were used by the various industries in the state and how shortages of certain resources affected industrial production and, consequently, the people in our state. The idea of recycling arose early in our class discussions of better ways to manage resources. During a brainstorming session on various materials that were suitable for recycling, I had an ideal opportunity to pose the question, "What can our class do to make recycling of discarded items more

*Edited by USMES staff

useful in our school?" After a time of random discussion in small conversation groups, I appointed a very able student to be the class discussion leader.

The discussion leader repeated the challenge that I had issued, wrote it on the board, and then asked the students for ideas that they felt were applicable. I was extremely pleased that as he listed the suggestions, he twice repeated the challenge and refocused the students' attention when they seemed to be straying from the subject. Once he remarked, "You must think of things the *class* can do, not what *you* can do outside school."

Among the ideas generated by the students were the following:

1. Save rubber bands from newspapers for school use.
2. Save "twisters" from bread wrappings for an undecided, future use.
3. Reuse posterboard (e.g., a blank side for a new project; if both sides have been used, use it for collages or a sturdy backing for another project).
4. Solicit old magazines and books from people in order to hold a book exchange or to make a donation to the library.
5. Make recycled goods to sell and then use the money for a class trip. (According to school policy, students are not allowed to sell items for a profit. Therefore, this idea was dropped from further discussions.)
6. Sponsor a flea market featuring unused items contributed from home.
7. Find out if light bulbs can be recycled.
8. Find uses for cardboard boxes.
9. Make new electric cords from old electric cords.
10. Collect items for use for "stuffing" (e.g., old panty hose, old pillows, old furniture stuffing).
11. Collect shoe boxes.
12. Collect wooden crates to use for firewood.
13. Collect items, such as buttons, yarn, carpet and fabric scraps, to use for art projects.
14. Collect coat hangers to sell at half a cent each.
15. Collect bed sheets to make bedspreads, curtains, table coverings.

Near the end of this session someone suggested placing two sheets of newsprint on the classroom wall so that any additional ideas could be recorded. The students were agreeable

to this plan, and they decided to identify their ideas by writing their initials after their suggestions. (The students at this age level are very conscious of being given "credit" for their work; evaluation was a real problem to them.)

The following day I used the overhead projector to display a transparency outlining all the ideas suggested by the students. After reviewing the list, the student discussion leader asked, "What are we going to do about the ideas we've suggested?" The other students proposed, almost unanimously, working in small groups because they felt it would be easier to share their ideas.

As the students met in four groups, I went from one to the other to listen to some of their ideas. I noticed that most students were still offering specific "doing" ideas rather than ways to fulfill the challenge. Each group had somehow selected a recorder with no instruction from me or the group leader. Because all the students were rather excited about their plans, the room was filled with the sounds of many conversations. I found it rather amusing when one of the students, who generally creates the most noise, commented to some of his classmates, "Be quiet! I can't hear my own group!"

Although the groups seemed somewhat hesitant to end their discussions, after ten minutes had elapsed, the student discussion leader reassembled the class. He listed the following ideas as they were reported by each group:

Group I
- Build a bookcase from bottles (they verbally sketched their plan).
- Survey people about recycling, for example, jewelry dealers, to find what things are really valuable in our society.
- Make Christmas decorations from recycled goods.

Group II
- Research recycling processes and costs and pinpoint it to our city.
- Gather returnable bottles for money.
- Collect litter and determine how we might recycle it.

Group III
- Sponsor a book exchange or flea market.

Group III (cont.)

- Visit recycling plants to see what can be done and how.
- Collect old bottles and cans for recycling.
- Find out what and how local companies recycle.

Group IV

- Determine items needed by various classes, especially for art and science.

As the list was written on the board, one student waved her hand rapidly and said, "I just thought of an idea. For art and stuff, we could get things from the textile company, like material and buttons." Her suggestion led to a more refined idea from the class to investigate the possibility of securing extra "stuff" from local industries.

After further discussing the various suggestions, the students agreed to work in groups that would concentrate on the following ideas:

- Research recycling techniques and plan a visit to a recycling plant.
- Scrounge items for reuse at school.
- Sponsor a book exchange and/or flea market.

The students readily admitted that they knew of no recycling plants in our immediate area, and so I suggested that this might be their first point of investigation.

At our next meeting the class decided to elect a chairman and an executive council to help coordinate their efforts. It took almost half an hour for the election of two co-chairmen and four executive committee members. (I have never seen such a democratic class; they voted on absolutely everything: how many people and which ones, whether to close the nominations, etc. I could see that they had been greatly influenced both by the recent state gubernatorial and school elections and by a social studies unit on voting procedures.) Their election was fair and well carried out. Interestingly, the people elected represented a cross section of our class in both ability and sex.

At the next class meeting the cochairmen said that, on the basis of time, the executive committee had concluded that the class should first work together on the recycling aspect, in particular, the recycling of metal, glass, and paper in our town. They appointed three group leaders and listed volunteers to work on each committee.

We spent the following two sessions investigating these three aspects and telephoning area companies that might be involved in recycling. The groups then reported to the class.

The Metal Group had located a local company that both purchased scrap metals and would allow our class to visit. (Although our class never made a field trip to this company, several of the students did visit with their parents.) The Paper Group, with great frustration, told how they had been unable to find any nearby center for recycling paper. The Glass Group had called three local soft drink bottling companies, all of whom said that they did not collect glass for recycling; the nearest place was in South Carolina. One of the group members said that his mother took glass for recycling to one of the companies, and he felt that perhaps the students who telephoned had not phrased their questions correctly.

As the groups concluded their reports, I questioned why they should engage in so many money-making collection activities. Their reply was for a class trip to "Six Flags Over Georgia," a "Disneyland" style recreation park in Atlanta. I reminded the students of the policy, adopted the previous year by our school board, that all class field trips be within a twenty-mile radius of our town and for academic purposes only.

After a time of pouting and disconsolate faces, one student suggested that we could use some of the money for developing a better school library, especially in the area of reference books needed by eighth graders for research projects. Someone else suggested that we could donate any money towards a recycling effort in Athens. We all agreed that both were good ideas that would probably be acceptable to school authorities because we wouldn't be trying to raise money for our personal use. The class concurred that further discussion should be tabled until we actually had money and needed to use it.

At this point the students completely dropped their money-raising plans to sell recyclable goods to companies; no one seemed concerned about whether we had accomplished the first phase or not. They decided that we should refocus our attention on surveying the school to determine what items were needed and then find out where to obtain them.

Just before the period ended, one of the girls asked, "What are we supposed to do about these groups we're in? In our group we don't feel that we're getting instructions from the executive committee." Many other students nodded in agreement. Our cochairmen made no reply, and with our

Scrounging Project

Group I-Investigating school needs
1 Devise a way to investigate school needs by talking to Blabock cat or writting out a ditto.

Group II-Investigating Industries
1 Find out what industries dispose of that we as a school. Make a list and then when group I finishes their list compare them and find out what can be used. Decide on a way to find out what they can give us. By sending a letter.

Group III-Recycle Store
1 Find out where we could have a store. How we could despence the items. If maybe some of the kids in school might want some goods we could sell them some.

Figure C4-1

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session coming to an end, I could only suggest that tomorrow they could outline on the board some direction the class might take which we could then discuss more fully.

The discontentment among the students did rouse at least one cochairman into action. The following day she came to class with a prepared ditto listing three groups which would concentrate more on the second phase of our plans--scrounging items for reuse at school. The ditto (see Figure C4-1) seemed to rejuvenate everyone's spirits, including mine. The students began volunteering for the groups, but only three people signed up for the Investigating School Needs or Survey Group, and so one of the cochairmen joined. I felt this was because she readily saw no leadership among the members who, although enthusiastic, were not academically advanced. The Investigating Industries Group was very lopsided because almost everyone wanted to participate in this group's activities, and approximately one-third of the class volunteered to help set up the store. After some time, the students did attain more of a balance in the memberships of the groups.

For the remainder of November the students worked primarily in the three groups, but we also held periodic class discussions during which we talked about the items that were being collected. Each group also reported on the progress to date, any difficulties encountered, and plans for the future. A brief description of each group's activities follows.

Recycle Store Group

Members of this group explained the purpose of our class activities to the principal, who gave permission for us to house our collected supplies in an unused storage closet. It was really small and very dirty, but the students were, nevertheless, quite excited.

Before this group could even clean the storage room for our use, they had to find new storage locations and then move an odd accumulation of materials, including two lawn mowers, assorted folding chairs, a bird cage, an old kiln, many 25-pound packages of clay, science lab stools, two old doors, and lots of junk. The riding lawn mower proved to be the most exasperating object because of its size and weight. In spite of concentrated efforts of measuring and turning it at different angles, the students were unable to move it through the partitioned door into another storage shed. They eventually had to seek assistance from the janitor who removed the door from its hinges.

The students formed an assembly line to transfer the 150

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Dear

We are a class working on a recycling project and we are trying to find out what the school needs in the way of discarded items like baby food jars, buttons and other items that industries throw away. We would like you to make a list of items your team needs and return it to room 41. Thank you.

Sincerely,

Briggs Patterson
JANICE SIMS
VANESSA COX
STAFFORD McKINNEY
RICHARD SHIELDS

Figure C4-2

packages of clay to two top shelves; one student stood on the floor, the second on a chair, and the third on a shelf as they passed the clay upward. When the various materials had been relocated, the group cleaned several inches of dust from the usable shelves and lined them with construction paper. They mopped the floor, and at last they were ready to start moving in the collected items which, in the meantime, had been sorted by the other groups.

When the final cleaning details were being completed, several members of this group helped with other activities. One of the boys designed and made a poster showing a "Mack" truck with "Hilsman Recycling Plant" written on the side, which he displayed on the storage room door as our trademark. Because the students were aware that it was against school policy to sell items for a profit, everyone seemed to adopt his poster idea of calling our recycling store a "plant."

Several boys from this group also discovered some old miniature houses that had been built in our shop many years ago. They dismantled them outside and then moved the wood to our plant, where they spent several sessions pulling out all the nails. The wood scraps and even some of the nails were definitely reusable.

Investigating School Needs Group

This group completed a letter to be sent to every head teacher, and one of the group members typed it (see Figure C4-2). During the same period that the letters were distributed, the students received one immediate request for baby food jars. The group's chore was then how to locate them--ask people, put up posters, contact people with young children. One girl later wrote a letter asking a teacher who had small children to save empty baby food jars. She replied favorably, and our source for baby food jars was settled.

Although most teachers promptly responded to the letter, the students found that they needed to write a personal reminder to several of them (see Figure C4-3). With the list of needed items growing, the group displayed the requests on posterboard so that the entire class could help with the collection. The list was reviewed during a class meeting, and many students responded with "oh" and "ah" as if they were aware that some of these items were at their homes.

DON'T
FORGET TO RETURN
YOUR RECYLING NEEDS
WE ARE WAITING
FOR THEM!

THANK YOU,
ROOM 41

Figure C4-3

List of Needed Items

Carpet samples	Wood scraps (sawdust)
Paneling samples	Boxes of any size
Fabric samples	Jars of any size
Buttons	Cans of any size
Discarded paint	Material scraps
Rope	Construction scraps
Wire	Rejected products
Thread	Twine

The students suggested various ways to collect some of the hard-to-find items. For example, for a request for telephone books, one student suggested that everyone could bring in old ones from home since new ones were then being distributed; for sawdust, someone noted that sweeping the floor in the shop area would probably fulfill our need.

When one teacher said she was "desperate" for forty-five stationery-size boxes, the class had an immediate request to fill. One student suggested that pencil boxes would be the approximate size to fulfill the purpose, and the class was able to scrounge the needed boxes from around the school.

The Investigating School Needs Group next started working on various other aspects of the collection. One boy made a container for discarded pencils, and three girls cut out letters reading "Recycle." They then collected and glued on litter from around the school to give their letters a three-dimensional effect. Their purpose was twofold: (1) to attract attention from students and teachers and (2) to make them aware that many items that were routinely discarded could be reused. Although the girls had originally planned to hang the sign on a back wall inside the storage area, the class was so pleased with the final effect that they decided to place it on the wall outside the plant so that everyone could see it.

After the sign had been up for several days, it, unfortunately, disappeared overnight. The students felt that none of their schoolmates would take it; their only answer was that one of the janitors had thought it was actually litter and had thrown it away.

Investigating Industries Group

Using the Yellow Pages in the telephone book, this group selected twenty-five local industries, including textile, paint, and lumber, which they thought might be able to provide discarded or overrun items. They spent quite a while

Gaines School Rd.

Athens, Ga. 30601

November 22, 1974

Gentlemen:

We are concerned 8th grade students from Hilsman Middle School. We are now involved in a recycling project. We are looking around for discarded items that could be of use to our school. Our teacher is Mrs. Malone.

Anything your establishment throws out or is of no more use to you, we would appreciate. These items can be anything from rejects to samples to waste to unusable materials. Our school can use alot of these things.

Our time is limited, so please give us a prompt reply. Tell us (if we can) what we can come and pick up and when. See enclosed list.

Sincerely,

Figure C4-4

drafting a form letter with an introduction explaining what they were doing and why they needed the discarded items. As they began to refine the letter, they even asked me for a copy of a business letter to use as a guide. They also attached the list of items that had already been requested so that the industries would have an idea of the types of materials we could use.

When their letter had been perfected and neatly copied by hand, the students went to the principal to secure approval for mailing. One of the group members then typed the letter on a ditto master (see Figure C4-4). It looked very professional except for one misspelling ("recycleing"), but the group decided to cross it out rather than retype the letter. Two students learned to use the ditto machine and made the needed copies. In the meantime, the other students obtained twenty-five envelopes and addressed them. There was quite a debate over how they should sign the letter--their names, my name, Room #41, Hilsman Eighth Grade. They finally decided to use "Representatives of Hilsman Recycling Plant" plus the names of several committee members. The signatures were rotated so that everyone had the opportunity to sign two or three letters.

Another dilemma arose over the proper way to fold a business letter. One student remarked that in typing class "you fold the salutation first," but another student disagreed. They finally compromised and folded the letter between the first and second paragraphs. With this issue settled, an assembly line quickly formed with three students folding the letters and two stuffing the envelopes.

This group had been quite concerned about receiving replies from the industries. They deliberated whether to enclose a self-addressed envelope or a postcard or just to assume that at least some industries would respond. Before the letters were sealed, they decided to enclose a stamped, self-addressed postcard to facilitate the return of their requested information. In addition to mailing these letters, two students telephoned local businessmen they knew and were promised that they would be informed if any discarded items were available.

As the students completed their particular group tasks, they readily found other chores that needed to be done, from scrounging materials at school to sorting the collected items. One of the boys, who felt that teachers always needed extra pencils for students who didn't have them, personally set out to collect "lost" pencils from around the school, especially from the front hall, the gym, and outside the building. He returned with forty-two pencils, most of

them collected under gym bleachers.

One student suggested to the class that we collect from the typing room the paper which had been used on only one side. Everyone felt that this was a good idea, and the recycled paper actually became one of our most requested items. A student visited the typing class several times a week to replenish our supply.

The class had originally planned to collect a wide assortment of materials, in addition to those specifically requested, and then to generate further interest in recycling by publicizing our large inventory. During a class meeting students suggested collecting plastic milk jugs and plastic wrappers from newspapers and bread. This prompted a discussion of the flow of goods, and the class decided that we shouldn't clutter our plant with available but useless items. Because plastic wrappers and milk jugs were not in demand at that time, they decided to postpone collecting in quantity any of these items until they were needed. As the students considered various items that had been requested, they devised the following list of goods which they felt would be constantly in demand and, therefore, would require a large supply:

1. Boxes
2. Plastic margarine tubs
3. Wood scraps
4. Small jars
5. Cylindrical cans (from oatmeal, coffee, lard)

They decided not to include temporary needs, such as the sawdust requested by the art classes for making puppets.

As supplies accumulated, students who had completed their group work sorted, categorized, and stocked them on shelves.* Our inventory included the following items:

Assorted glass jars	Scrap paper
Baby food jars	Old metal bookcase
Boxes	Old clothes (for fabric)
Plastic Bags	Rope
Plastic food tubs	Plastic Silverware trays
Pill bottles	Tin Cans
Wire	Paper bags

*The students might also make a flow chart of the storage area to decide on the best placement of materials by placing the most requested items in the most accessible location.--ED.

Inventory

1 large fry pan
48 paper bags
21 plastic bags
4 pie tins
29 baby food jars
6 boxes
4 milk cartons
2 large boxes of wood scraps
49 glass jars
24 cans
1 large box papers
1 coil of wire
1 " rope
22 coat hangers
12 pencils

Figure C4-5

Scrap wood
Two pie plates
Sponges
Egg cartons
Pencil stubs
Old telephone books

Two boys became self-appointed inventory-keepers and shelf-stockers. Every three days they recorded the items and quantities on hand (see Figure C4-5). Later they refined their method and used a tally system to record the inventory in an old ledger. Using a checkbook method, they left spaces for adding and subtracting the number of goods received and distributed so that their inventory sheet for each item was similar to the following:

Date	In	Item	Out
4/8/75	𝍸 𝍸 |	Paper Bags	𝍸 |
4/11/75	𝍸		𝍸
4/16/75	||||		0

Two other boys, who had spent such a long time removing nails from the scrap wood, drew a rough sketch of plans for more shelves to use in our plant (see Figure C4-6). When they presented them to the class, other students commented that the shape was "odd" and that the shelves should be larger. The boys gave a very good defense of their design, explaining that the dimensions represented the measurements of the scrap wood they were using. They felt that in order to meet their challenge to make discarded items more useful, they needed to use this discarded wood rather than cutting up larger pieces. This argument seemed to satisfy the rest of the class.

When the boys later began construction, they found that they were unable to brace the shelves adequately. Therefore, they adopted a new design for two separate tables which, when completed, really improved the appearance of the plant. It ceased looking quite as messy because there was more storage space for supplies.

We had also begun to receive a few replies from industries, but they were generally disappointing. A local bottling company said that they collected glass for recycling and they commended the students for their efforts. We were also offered free plywood scraps, some measuring as large as 4' x 6', if we would pick them up in an adjacent town. One postcard offered both wood and carpet scraps, but the man who had signed it failed to indicate either his company or his address. Because the students could only guess which of several companies he might represent, they

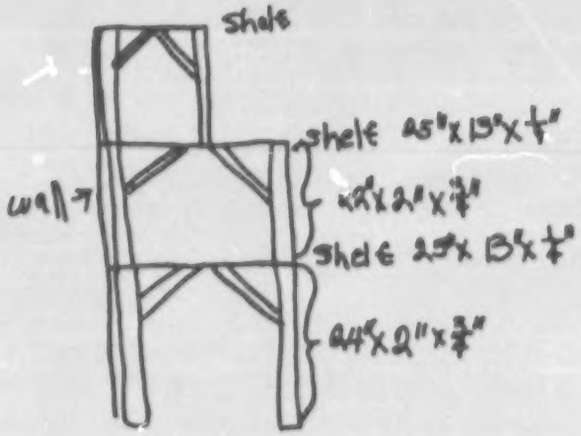

Figure C4-6

used a telephone book to find his home number. Unfortunately, it had been disconnected and no new number was available. In spite of their efforts, the students were never able to associate the man with his company.* We were all extremely disappointed that so many industries had failed to respond, especially because the students had gone to the trouble and expense of including the stamped postcards with their letters.

From the time that the Survey Group had first talked with the teachers, we had been filling their requests. The Survey Group also devised ads for our daily bulletin that reminded the teachers about our supply of materials (see Figure C4-7). The students were really elated when they received requests which they were able to fill immediately.

HILSMAN DAILY BULLETIN

61st. School Day — Nov.22, 1974

ANNOUNCEMENTS

An eighth grade social studies class is concerned with recycling. They have opened the Hilsman Re-cycling Plant on the lower hall. If you have any items at home that could be used in science or art classes, etc., please bring them to school. We especially need small glass jars, wood scraps, cylinders (such as coffee or oatmeal cans), plastic food tubs, any size. Please send these items to Room 41.

ANNOUNCEMENTS

64th School Day — Nov. 27, 1974

Teachers! Do you have any need for any of the following items? Come between 9:30-10:20 to the Re-cycle Store:

scrap wood	baby food jars	glass jars
phone books	plastic medicine bottles	pencil stubs
paper used on one side	tin plates	plastic bags
egg cartons	cans or scrap metal	butter & other plastic containers
paper bags	and many other items!	

Figure C4-7

During one busy day we filled four separate requests: fifteen telephone books to the business class; fifteen pill bottles and several jars to science; recycled paper to two communications classes; and baby food jars to the art room. At times some requested items were not in our inventory (e.g., empty food boxes with marked prices for a math class), and the Inventory Group alerted the class to a new need. A

*The students might number each reply card before mailing them. A list of all the industries and the number of the postcard assigned to each could then be used to identify each reply.--ED.

New Groups for Recycling:

FLEA MARKET & BOOK FAIR will be a fair for old books and "garage sale" items to be recirculated.

Groups:

1. PLACE GROUP

Find place we could use for our "garage" sale. Also find the time we could use it, etc...

2. PUBLICITY GROUP

Your job is to tell people about the fair and exchange. Make posters for around the school, Golden Pantry, etc. Put ads on radio, maybe newspapers, etc. Put items in school bulletin.

3. FAIR GROUP

In charge of fair & exchange. Must set prices (if needed), categorize and organize items, etc.

Note: group 3 cannot work until group 1 has finished.

Figure C4-8

few requests did cause some real "finding" problems, such as a very lengthy request for items including metal disks, bamboo, and metal cans.

One very interesting request was for a 34 cm x 50 cm box. Because most of the students were just beginning to work with the metric system, there was quite a discussion of exactly what size box was needed and how many inches were in a centimeter. To this latter query, the students' answers included "a degree," "five inches," "one-hundredth of a millimeter," and "about three inches." To obtain the correct answer, they decided to ask the math teachers but found they were all in class.

As the students were looking at their standard measurement rulers that they used every day, they "discovered" for the first time that the reverse side was marked in metric units. With their new-found knowledge, they set out to measure boxes ranging from file cabinets to pencil boxes but were unable to find the needed size. One student finally cut out a pattern from old newspaper so that they would have an idea of the approximate size.

When the students were able to visualize the needed size, they hypothesized that the box in which notebook paper was sent to the school office would at least approximate the size. This proved to be a close guess--the box measured 32 cm x 50 cm and was acceptable to the teacher requesting it. I really felt that this activity involved as many students in thoughtful, active work as had anything else to date. The students really seemed intent on solving this measurement "puzzle," and I'm sure that their knowledge carried over into math class.

The news of our recycling effort seemed to be spreading throughout our community. One day the mother of a sixth-grade student, who was not in any of my classes, brought in two very large stacks of assorted glass jars, everything from baby food jars to wine bottles. She explained that her family was interested in helping our class because they, too, felt that recycling was important.

Toward the end of November our student discussion leader surprised everyone by distributing to the class a dittoed sheet which announced new groups for a flea market or book exchange (see Figure C4-8). He explained that we needed to look ahead to another phase because most of the groups had basically completed their work or were just waiting for additional information to arrive. There was some confusion about who would continue to work on the scrounging phase and what new groups were actually needed.

With everyone talking at once and offering suggestions,

the leader turned to me and said, "I was so organized this morning and now *I'm* so confused." He decided it would be best to list all the needed groups on the board and explain the purpose of each.

Scrounging: Continue to find goods, stock shelves, keep inventory, and generally maintain the functioning of our recycling plant.

Place: Find a location for flea market and/or book exchange; check with principal for authorization.

Publicity: Advertise our activities.

Fair/Exchange: Manage the actual event.

The students understood the thorough explanation, and volunteers again signed up to work on the committees. One student mentioned that the entire class should extend the scrounging effort because that part of their challenge had not been adequately fulfilled. Although there was unanimous agreement on this point, the students felt that until they received additional requests from teachers and responses from industries about new supplies, there was little they could do.

Three girls who volunteered for the Place Committee were very concerned that the class could not do a good job of sponsoring both a flea market and a book exchange before our agreed deadline, the December holidays, which were only three weeks away. Therefore, they agreed that the class should sponsor only the book exchange with a possible date set for Friday, December 13.

Various methods for exchanging books were discussed, and one girl said, "Let's not charge much because everyone should have a book if he wants one." They decided that one book could be swapped for another and that a small fee of 10¢ would be charged to anyone who didn't have a book to trade. Any money they earned and any leftover books would be donated to our library. With their basic plans formed, the girls spoke with the principal, who gave permission for them to proceed with the exchange.

At our next session the girls reported to the class, and everyone concurred that they had made the right decisions. The girls added that *every* person in the class was expected to donate five books for the exchange. The cochairmen later organized the students into the following three groups to

..TRADE...TRADE...TRADE...TRADE...TRADE...TRADE..

OR 10¢

Students!

Tired of your old books? Want new ones? Want to get rid of your old ones?

Well.... we have a way of solving your problem. On December 12th + 13th we are having a book exchange. All you need to do is bring in your old books on the 12th + 13th and exchange them for books others have read. If you don't have books, you can purchase books for 10¢.

Your teacher will bring you to the library and we will be there to show you the books we have.

This is a smart way to conserve paper and money.

Figure C4-10

work on advertising methods:

1. Make intercom announcements each afternoon, put notices in both the student and teacher bulletins.

2. Devise and ditto leaflets for the classrooms.

3. Make posters.

For the next three weeks the class concentrated on the arrangements for the book exchange. However, various activities concerning our scrounging effort and recycling plant also continued as they were needed. The activities of the three publicity groups--intercom, leaflets, and posters--are described in the following paragraphs.

The Intercom Group wrote ads that were read over the public address system for three days preceding our sale. Most were humorous "poems" and evoked comments--"That's corny"--from the students who, nevertheless, enjoyed them. This group also wrote announcements for the daily bulletin. (See draft of one announcement in Figure C4-9.)

The Leaflet Committee initially planned to use recycled paper to print a notice for every student in school. However, when they found that they would need 900 leaflets, they were so stunned that they amended their plans. Instead, they chose to post one leaflet in each classroom. After completing the draft (see Figure C4-10), the students dittoed their leaflets on recycled paper and later posted them in the fifty or so classrooms.

The Leaflet Group then reconsidered their first plan to give a notice to each student in school. They found that by spacing five short notices on a single ditto, they could reduce the sheets of paper needed to only 180. (See copy of notice in Figure C4-11.)

Students. The 8th grade Recycling class is having a book Exchange on December 12 and 13th. We would like you to bring any old book and exchange it for another. If you don't have an old book bring money. Books will be between 0 and 75 cents. No magazines please.

Bulletin.

Figure C4-9

Students!

Dont forget about the book exchange on December 12 and 13!!! Bring your old books and or ten cents. Your teacher will get you to the library du-ing either of these days.

Figure C4-11

However, while they were duplicating, they still ran out of recycled paper from our plant. Because I would not let them

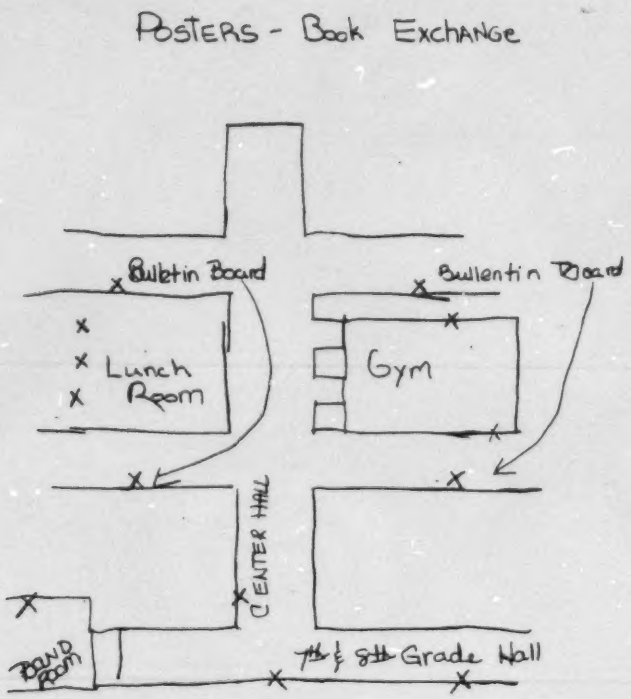

Figure C4-12

interrupt classes to ask for paper, they decided to try using notebook paper. They scrounged an unbelievable quantity of partically used paper just from the members of our class, and it sufficed for the emergency situation. They used a paper cutter and sorted the notices into groups of 100 (for approximately 100 students in each of nine teams) which were then delivered on the day before our exchange to all head teachers.

After unsuccessfully trying to locate used posterboard, the Poster Committee resorted to using large construction paper. When they had completed the thirteen poster designs, they presented them to the class for approval. The committee also drew a hastily sketched map of the school to determine the best locations for displaying the posters. (See Figure C4-12.)

In arranging the schedule for the book exchange, the students felt that they could not easily accommodate all 900 students in one day. Therefore, they decided to hold the exchange on two successive days--Thursday, December 13, for sixth and seventh graders and Friday, December 14, for eighth graders. They used a master schedule from the office to work out the time slots for each language arts class, taking both lunch periods and class changes into consideration. Letters indicating visiting times were written and delivered to each head communications teacher.

As the students began to bring in their required five books, a group formed to code "ReP" (for Recycling Plant) in red pencil on the title page. They explained that this was to prevent people from "ripping off" their books. All newly traded books were to be coded during the exchange.

Within three days we accumulated approximately 200 books, and the students realized that they needed to sort them into categories. Someone from this group seemed to be forever running out to get another box for a new category they had just thought up. It also seemed at first that nothing would ever really be accomplished because the students were "ahing" over the books they wanted and recalling the ones they'd read. They finally decided on the following categories:

Reference
Sports
Mystery
Adventure (fiction and nonfiction)
Animals
Sophisticated (defined as harder to read or for "smarter" students)
Puzzles/Activities, Jokes

The Sorting Group developed their own system, so to speak, for categorizing books with which they were unfamiliar. Either they asked whether anyone had read the book, they read the jacket flap, or they briefly scanned the pages at several intervals. In spite of some student opposition, they decided to withhold from their supply four books which they felt would have too many "X-rated" scenes and also a controversial book by Abbie Hoffman. I thought it was good that the students could decide without adult prodding that some books might not be acceptable for a school event.

As they looked over the collected books, the students had a real change of heart concerning their proposed 10¢ charge. One boy mentioned that with such a low price we could conceivably sell *all* our books to just *one* class, thereby discouraging trade and depleting our supply. When this issue was presented to the entire class, the students agreed that our policy should be adjusted. They decided that a pricing committee should price each book between 10¢ and 75¢. This change in plans necessitated a quick revision for the Poster Group who quickly ammended their signs to read "10¢ and up" or "10¢ & ↑" depending on available space. Corrections were also made on the leaflets and bulletins.

The Pricing Committee immediately noticed price inconsistencies when all members were individually pricing books. They reorganized and formed a small assembly line with two students attaching masking tape price tags, two marking prices, and two resorting. Although the class had set an upper limit of 75¢, there were still several books for which they just couldn't charge such a low price. One was a single encyclopedia volume which the library couldn't use. The group priced it at $2.00 and laughingly told me, "There is always an exception to the rule." Another exception was a new $6.95 hardcover book, *The NFL Today*, which they priced at $1.50.

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Because the students were afraid that their supply might be depleted before all classes had an opportunity to visit the exchange, they decided to limit each customer's purchase to three books. They agreed to place no restrictions on the number of books traded.

Making tokens for traded books was the next undertaking of the Price Group. They asked the class for advice on what materials to use, and the following ideas were suggested:

Marked bottle caps
Poster or construction paper cutouts
Play Money
Rubber stamp to mark customer hands

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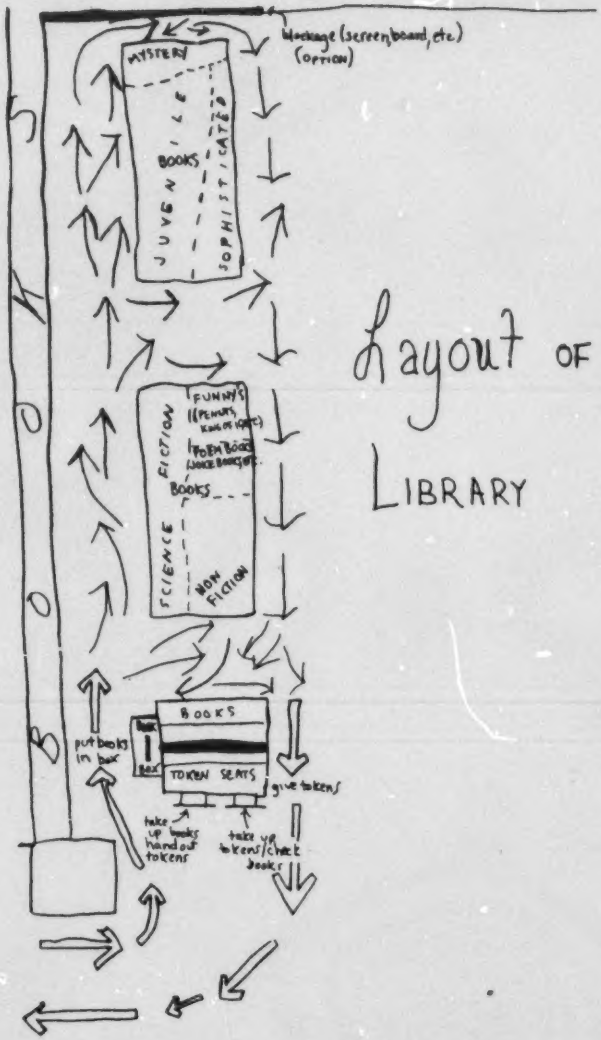


Figure C4-13

For one reason or another, each suggestion seemed to create another problem. The cutouts and bottle caps were too easily duplicated or destroyed; the rubber stamp was messy; no one had any play money. The final suggestion was to see whether anything in our plant could be used.

The group did find the makings for their tokens in our plant. They used heavy cardboard cylinders which had come from the centers of wrapping paper. After measuring the length of the cylinders and marking thirty equal portions, they cut them out with an "X-Acto" knife. The plain cardboard ones were used for Thursday's exchange and the yellow ones for Friday's, just in case there was any problem. They were not sure what problem might develop, but they wanted to be prepared for various possibilities.

The class obtained permission to hold our book exchange in one area of the library. A group of students investigated the layout and drew a rough traffic flow diagram indicating a proposed setup and flow of customers. (See Figure C4-13 for a later, refined version.) Because other students would be simultaneously using the library and because my students were concerned about security, separating our area was a real concern. The group finally secured folding screens from the Home Economics department. Signs were made to indicate the traffic entry and exit routes and also the book categories. The students measured a table in my room and took off the removable legs so that it would be easier to move to the exchange area. We then had three tables for displaying books. Areas were designated for exchanging tokens and for making payments. One girl used contact paper to decorate an old jewelry case which was used as our money box because it could be locked. Students brought in $3.00 worth of dimes and nickels to use for making change.

Another major activity involved the scheduling of student workers. The group that had planned the physical layout decided six workers were needed: two people to check in and check out books, tokens, and/or money; one person to work at each of the three display tables; one person to be the "security patrol" and to oversee the entire operation. Everyone was very eager to work, but I did put on one restriction: each worker must have a signed note from the teacher of the class from which the student would be excused; anyone failing a class or in danger of failing would not be permitted to miss that class. This did dampen the spirits of several students who had anticipated missing a particular class. However, everyone in the class was able to work at least one shift. One of the students made a master list of workers and responsibilities which was distributed to everyone (see Figure C4-14). A master schedule was posted in our

Employees in Book Exchange

There are six (6) employees needed in the library at each period.

1. Checkout People- we need one (1) person to take up books as people enter. They will give you their book and you will give them an Exchange token. You will also take up their money and give them a Money token, if they have money

We need (1) person to take up tokens as they go out, check their books to make sure they are not library books.

2. Help People - We need one (1) at each table to make sure they don't rip off (steal) a book. Also, help them to find a book.

3. Patrol - We need one (1) person to patrol along the wall and make sure a person doesnot steal a library book. (S)He also will take books out of book box and sort themonto the tables

Figure C4-14

room, and names were checked off as the students returned the notes signed by their teachers.

On the day before our first exchange, we held a class discussion to go over last minute details. One student discussion leader reviewed the various responsibilities of the workers and drew a diagram of the exchange layout so that everyone would better understand where they were to be located. The question was raised whether one or two people would stay on the exchange staff all day to provide some continuity of organization. Many volunteers immediately offered to assume this duty. We were finally able to choose two students with no pressing class activities who would be able to attend the exchange for most of the day.

On the day of our exchange I picked up several students so that we would arrive at school early enough to prepare everything for the arrival of the first class. Because I had classes to teach, the actual running of the exchange was left entirely to the students. I was able to look in occasionally, and the students were permitted to come to my room if they experienced overwhelming difficulties. They did visit three times: (1) to get change for a $5.00 bill; (2) to find a substitute worker for one who had become ill; (3) to ask if they could go to lunch in pairs rather than one at a time.

When I first looked in on the exchange, it was apparent that we had not provided a large enough area for our customers to browse through the books. In such an open space as in our library, it was very difficult to have the flow of people that we had desired, and security was impossible. The workers reported that the first class had purchased cheap books which they then gave to friends to exchange for more expensive books. This, coupled with lost books, meant that we were trading many of our own books during the first few hours. The students themselves corrected this situation by refusing to accept any books which contained our coded ReP. As one of our books was bought or sold, the check-out person drew a line through our code and initialed it. Afterwards, we had no further problems of this nature.

Although the students tried to keep a tally of the number of books traded and purchased, they found it difficult because at times things were moving very quickly, and the change in shifts increased the likelihood of inconsistency. The students had prepared a survey to assess the effectiveness of their different advertising methods, but they found it almost impossible to administer. Some customers didn't have pencils, and those who did crowded around the checkout table and caused confusion for the workers. Some of the

PROBLEMS

1. People roaming around bugging us. N.T.
2. People asking questions like they're casing the place. V.G.
3. People buying a cheap book (15¢ or 10¢) and trading it for a expensive one ($50 $1.00) C.D.
4. If would help if teachers came with the students.
5. People trying to steal books.
6. - 6th should come by themselves - hard for them to make up their minds which books. J.S.
7. - Needed more change$ (J.S.) also- teachers should trade too so they won't buy the best books.

Figure C4-15

workers forgot to distribute it, and finally the Survey Group decided that the results would be so inaccurate that they discontinued it.

During the first day of the exchange, the students noted that the teachers accounted for the largest quantities of purchases and, therefore, for the most sales. The sixth graders bought more juvenile books and didn't seem to be particularly interested in the sports category. Many of the eighth graders were so excited about the exchange that they kept floating into our area, even though they weren't scheduled to attend until the second day. Finally the workers made a list on the bottom of their tally of those students who kept pestering them. They also made a list of problems (see Figure C4-15) that they had encountered or had observed.

By the end of the first day we had traded over 200 books and had sold 76 books. (See tally in Figure C4-16.) The workers were really exhausted, and they made a very good suggestion: "Do one grade each day by themselves." They were also concerned that they would have neither the quantity nor the higher reading level of books needed for the eighth graders. An SOS was sent to all members of our class to bring additional books for the next day.

For the second day of the exchange, the students widened our area so that both the customers and the workers would have more room. Our class brought in over forty additional books, some of which were the best we had obtained. They were quickly priced and categorized.

The news of our exchange had really spread, and the older students were literally bringing in sacks of books; one boy brought fourteen good, eighth-grade level books to trade. As our first day had been such a hit with the sixth and seventh graders, many of them brought in books that they wanted to trade the second day. We had to make a quick policy decision regarding returning customers. My students felt that because eighth graders had not yet had an opportunity to visit our exchange, they should rightfully have their day without disturbance from the lower grades.

The second day was much calmer in all respects, and the workers had no need to list problems. Over 130 books were traded and 75 were sold. The students observed that the science fiction books were again the most popular, with mysteries a close second. Novels went well but could not be adequately judged because the number donated was small. Old high school and college texts did not move well either day, and only a very few juvenile books were traded to the eighth graders.

By the end of our two-day exchange we had earned $27.85

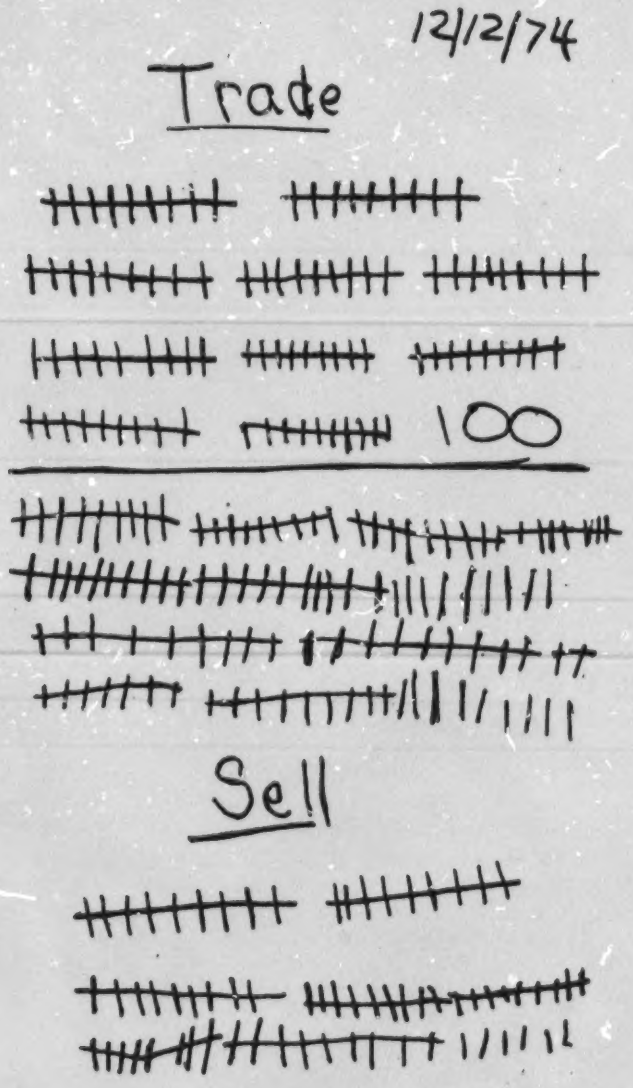


Figure C4-16

from sales, and there were still approximately two and one-half boxes of leftover books. We really felt that the book exchange had been a huge success, and the students were very pleased when they were able to donate the funds to our library.

Because of so many student requests, we considered sponsoring a second exchange in the spring, but it never really got off the ground. It seemed that all my students had contributed so many books the first time around that we could not collect enough books for another basic inventory. We finally resorted to our original plan of donating leftover books to the library. The librarian selected appropriate ones and returned the others to us. The students used these to set up a "freebie" table from which anyone in school could select free books to keep for personal use.

After the holidays we scheduled no further formal USMES sessions for the School Supplies unit. However, work did continue throughout the school year in an indirect manner relating to the collection and distribution of materials.

One of the problems we encountered was an oversupply of items. The students had been so reliable about collecting materials that our recycling plant seemed to be overflowing. During a class discussion one student suggested writing a letter to the visiting art director of three neighboring elementary schools, offering our supplies for her use. The director was delighted and telephoned one of the students to request many items (e.g., wrapping paper, egg cartons, various colors of string and yarn, burlap, buttons, and jars in assorted sizes). Because we had so many egg cartons in stock, this item was easily obtained. In fact, the students started collecting them again and kept sending her so many that she finally had to call back to say, "Stop!" The jars were also readily supplied.

It took more thought to obtain the buttons, yarn, and string. One group of four students got in touch with people at several textile plants who had not replied to our letter. The students felt that they would have more leverage in their second requests when they mentioned the lack of response. One company did offer string, but it was so tangled on the rolls that it appeared useless. The students decided to accept it anyway, just in case it might be used.

Both yarn and overrun buttons were sold by two firms through their outlet stores. The students felt that even though these materials were not free, the prices were very reasonable. They decided that the knowledge they had found was so useful that they passed it on to teachers at our school and at the elementary school.

The students were also excited to learn that our art teacher bought bulk carpet yarn from her hometown about seventy-five miles away. The students felt that the savings were so substantial that our entire district would benefit from sending a representative there twice a year to make purchases for our system's art needs. Although they never followed through on their idea to inform the school board, they did tell our second art teacher and the viriting elementary art director.*

Although the students tried to find burlap from feed companies, none was available. The elementary teacher, nevertheless, seemed very appreciative of all our efforts. I felt the students had done a real service, and they were able to make further use of our large inventory.

In our own school the art department continued to request jars and bottles. As of March 29 we had supplied fifty-seven bottles to use in making collage vases. A request from the science classes for prescription-type medicine bottles resulted in almost 100 being collected in less than a week. The students were really surprised that people would consume so many pills. This led to a very serious discussion of our society's escape mechanisms.

Near the end of the school year we discussed what we should do with remaining supplies. The students decided that some items, including over 100 plastic milk jugs, should be thrown away at the county dump. Other materials that still had some value were saved or offered to students. Items that could be recycled were taken to appropriate locations and either donated or sold by the students. We felt very hesitant about disposing of some things, such as paper bags from grocery stores. Our intuition did pay off in this instance; our bags became the "luggage" for carrying school supplies and gym clothes when the students cleaned out their lockers.

Our recycling plant had fulfilled many needs during the year. Perhaps one of the least impressive but most successful functions of our plant was to provide old ditto paper for reuse on one side. The students became so conscious of waste that they were shocked when one teacher printed a memo on clean paper leaving nearly three-quarters of each

*The students might become interested in investigating the supplies purchased by the school to see whether substantial savings could be made by buying different items or the same items from different sources.--ED.

sheet unused. This teacher must surely have been an exception because many others told me that the awareness brought to them and their students by our efforts was very impressive and meaningful.

D. References

1. LIST OF "HOW TO" CARDS

Below are listed the current "How To" Card titles that students working on the School Supplies challenge might find useful. A complete listing of both the "How To" Cards and the Design Lab "How To" Cards is contained in the USMES Guide. In addition, the Design Lab Manual contains the list of Design Lab "How To" Cards.

GRAPHING

GR 1 How to Make a Bar Graph Picture of Your Data
GR 2 How to Show the Differences in Many Measurements or Counts of the Same Thing by Making a Histogram
GR 3 How to Make a Line Graph Picture of Your Data
GR 4 How to Decide Whether to Make a Bar Graph Picture or a Line Graph Picture of Your Data
GR 5 How to Find Out If There is Any Relationship Between Two Things by Making a Scatter Graph
GR 6 How to Make Predictions by Using a Scatter Graph
GR 7 How to Show Several Sets of Data on One Graph

MEASUREMENT

M 1 How to Use a Stopwatch
M 2 How to Measure Distances
M 9 How to Make a Conversion Graph to Use in Changing Measurements from One Unit to Another Unit
M 10 How to Use a Conversion Graph to Change *Any* Measurement in One Unit to Another Unit

PROBABILITY AND STATISTICS

PS 2 How to Record Data by Tallying
PS 3 How to Describe Your Set of Data by Finding the Average
PS 4 How to Describe Your Set of Data by Using the Middle Piece (Median)
PS 5 How to Find the Median of a Set of Data from a Histogram

RATIOS, PROPORTIONS, AND SCALING

R 1 How to Compare Fractions or Ratios by Making a Triangle Diagram*
R 2 How to Make a Drawing to Scale
R 3 How to Make Scale Drawings Bigger or Smaller

*Now called slope diagram.

New titles to be added:

How to Round Off Data
How to Design and Analyze a Survey
How to Choose a Sample
How to Design an Experiment
How to Make and Use a Cumulative Distribution Graph

A cartoon-style set of "How To" Cards for primary grades is being developed from the present complete set. In most cases titles are different and contents have been rearranged among the various titles. This additional set will be available in 1977.

2. LIST OF BACKGROUND PAPERS

As students work on USMES challenges, teachers may need background information that is not readily accessible elsewhere. The Background Papers fulfill this need and often include descriptions of activities and investigations that students might carry out.

Below are listed titles of current Background Papers that teachers may find pertinent to School Supplies. The papers are grouped in the categories shown, but in some cases the categories overlap. For example, some papers about graphing also deal with probability and statistics.

The Background Papers are being revised, reorganized, and rewritten. As a result, many of the titles will change.

DESIGN PROBLEMS

DP 13 People and Space by Gorman Gilbert

GRAPHING

GR 3 Using Graphs to Understand Data by Earle Lomon

GR 4 Representing Several Sets of Data on One Graph by Betty Beck

GR 6 Using Scatter Graphs to Spot Trends by Earle Lomon

GR 7 Data Gathering and Generating Graphs at the Same Time (or Stack 'Em and Graph 'Em at One Fell Swoop!) by Edward Liddle

GROUP DYNAMICS

GD 2 A Voting Procedure Comparison That May Arise in USMES Activities by Earle Lomon

MEASUREMENT

M 3 Determining the Best Instrument to Use for a Certain Measurement by USMES Staff

PROBABILITY AND STATISTICS

PS 1 Collecting Data in Sets or Samples by USMES Staff

PS 4 Design of Surveys and Samples by Susan J. Devlin and Anne E. Freeny

PS 5 Examining One and Two Sets of Data Part I: A General Strategy and One-Sample Methods by Lorraine Denby and James Landwehr

RATIOS, PROPORTIONS, AND SCALING

R 1 *Graphic Comparison of Fractions* by Merrill Goldberg
R 2 *Geometric Comparison of Ratios* by Earle Lomon
R 3 *Making and Using a Scale Drawing* by Earle Lomon

3. BIBLIOGRAPHY OF NON-USMES MATERIALS

The following are references that may be of some use during work on School Supplies. The teacher is advised to check directly with the publisher regarding current prices. A list of references on general mathematics and science topics can be found in the *USMES Guide*.

American Paper Institute. *"Things to Do at Home."* 260 Madison Avenue, New York, New York 10016.

_____. *"How You Can Make Paper."* (One pamphlet free on request.)
Instructions for making small quantities of recycled paper from tissues. Also contains a brief explanation of different substances used to make paper and paperboard.

The Children's Museum, Resource Center, The Jamaicaway, Boston, Massachusetts 02130. *Recycle Notes*. ($1.30)
An illustrated booklet with many ideas and instructions on how to use recycled materials for education and craft projects. Among the ideas presented are various games, simple musical instruments, masks, equal arm balance, water microscope, ant farm, weaving looms, and simple ways to print.

Workshop for Learning Things, 5 Bridge Street, Watertown, Massachusetts 02172. *Paper Making Kit*. ($68.00)
All needed materials and instructions for a simple method of making small quantities of paper. A more complete description is given in *Our Catalog* ($1.00) available from Workshop for Learning Things.

4. GLOSSARY

The following definitions may be helpful to a teacher whose class is investigating a School Supplies challenge. Some of the words are included to give the teacher an understanding of technical terms; others are included because they are commonly used throughout the resource book.

These terms may be used when they are appropriate for the children's work. For example, a teacher may tell the children that when they conduct surveys, they are collecting *data*. It is not necessary for the teacher or students to learn the definitions nor to use all of these terms while working on their challenge. Rather, the children will begin to use the words and understand the meanings as they become involved in their investigations.

Accounts Payable	A current liability representing obligations to pay a creditor, usually a supplier.
Accounts Receivable	A current asset representing obligations owed to a company, usually by its customers.
Asset	Anything owned that is measurable in terms of money.
Average	The numerical value obtained by dividing the sum of the elements of a set of data by the number of elements in that set. Also called the mean.
Barter	To exchange one piece of merchandise for another.
Bookkeeping	A system for recording business transactions.
Comparative Shopping	A method for determining the best buy(s) by comparing the costs, quantities, and qualities of different brands of products.
Consumer	A person who buys or uses goods or services.
Conversion	A change from one form to another. Generally associated in mathematics and science with the change from one unit of measure to another or the change from one form of energy to another.
Correlation	A relationship between two sets of data.

Cost — The amount of money needed to produce or to purchase goods or services.

Cost Accounting — That form of accounting designed to provide management with cost information.

Data — Any facts, quantitative information, or statistics.

Discount — A reduction in the price of products or services, often stated as a percentage of price. This is done (1) for customers who buy in large quantities or (2) in order to generate a greater volume of sales.

Distribution — The spread of data over the range of possible results.

Dividend — Payment in either cash or stock to the holders of a company's stock.

Economics — A social science concerned chiefly with description and analysis of the production, distribution, and consumption of goods and services.

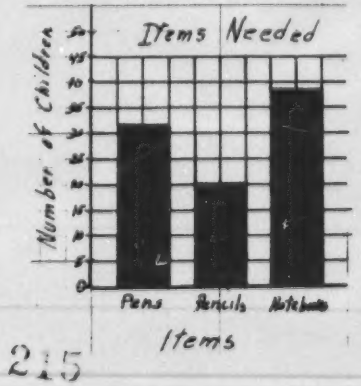
Event — A happening; an occurrence; something that takes place. Example: a step in the production process.

Frequency — The number of times a certain event occurs in a given unit of time or in a given total number of events.

Graph — A drawing or a picture of one or several sets of data.

Bar Graph — A graph of a set of measures or counts whose sizes are represented by the vertical (or horizontal) lengths of bars of equal widths. Example: the number of children who would buy certain items from the school store.

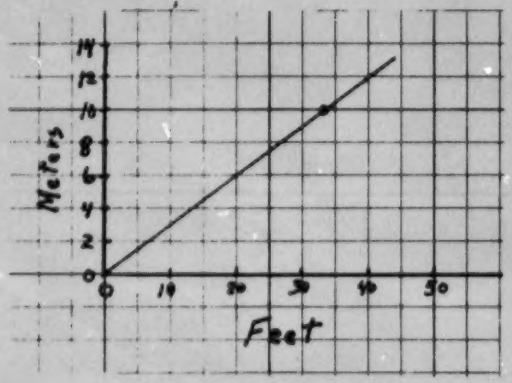
Item	Number of Children
Pens	32
Pencils	20
Notebooks	37



Conversion Graph

A line graph that is used to change one unit of measurement to another. For example, changing meters to feet or vice versa.

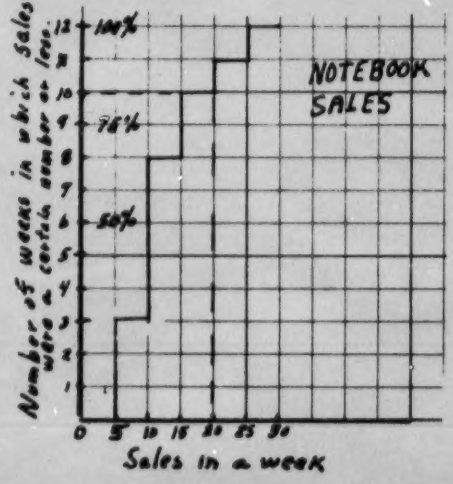
Meters	Feet
10	33



Cumulative Distribution Graph

A graph that can be constructed from a histogram by computing running totals from the histogram data. The first running total is the first value in the histogram data (see table of values). The second running total is the sum of the first and second values of the histogram, and so on. The horizontal scale on the graph is similar to that of the histogram; the vertical scale goes from 0 to the total number of events observed (in the example, total number of weeks recorded). Each vertical distance on the graph shows the running total of the number of observations that are less than or equal to the value shown on the horizontal scale; thus the graph below indicates that in ten weeks (or about 80% of the weeks) twenty notebooks or less were sold.

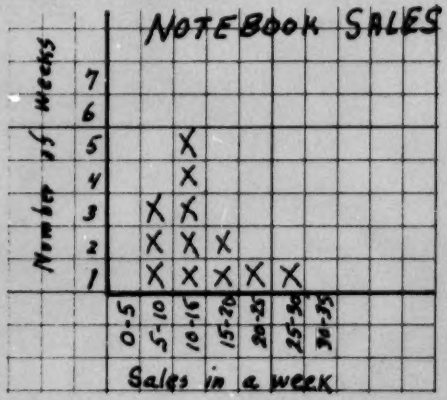
Sales in a week.	Running total number of weeks
5 or less	0
10 or less	3
15 or less	8
20 or less	10
25 or less	11
30 or less	12



Histogram

A type of bar graph that shows the distribution of the number of times that different measures or counts of the same event have occurred. A histogram always shows ordered numerical data on the horizontal axis. Example: number of weeks that different numbers of notebooks were sold.

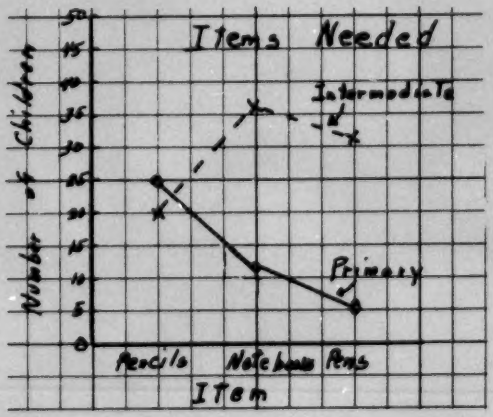
Sales in a week	Number of weeks
0-5	0
5-10	3
10-15	5
15-20	2
20-25	1
25-30	1



Line Chart

A bar graph that is represented by circles, crosses, or triangles with lines connecting them so that it has the appearance of a line graph. (See *Line Graph*.) This is a useful representation when two or more sets of data are shown on the same graph. Example: number of students in primary and in intermediate grades who would buy certain items.

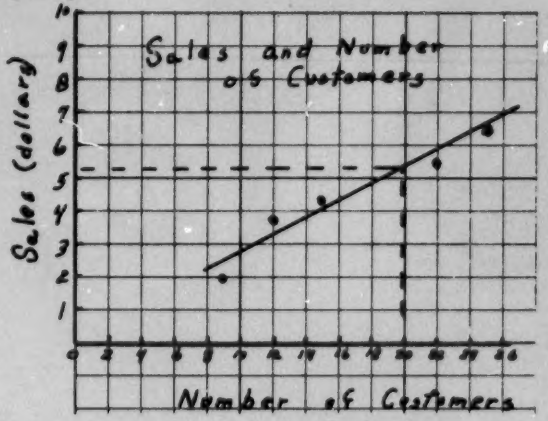
Item	Number of Primary	Number of Intermediate
Pencils	25	20
Notebooks	12	37
Pens	5	32



Line Graph

A graph in which a smooth line or line segments pass through or near points representing members of a set of data. Since the line represents an infinity of points, the variable on the horizontal axis must be continuous. Example: number of customers in a day vs. amount of sales. The approximate amount of sales for a twenty-customer day can be found from the graph, even though there were not exactly twenty customers recorded on any day.

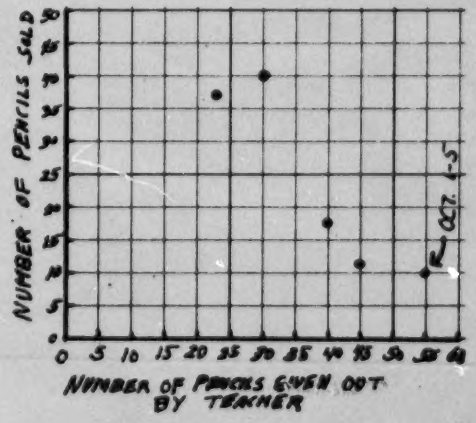
Number of Customers	Amount of Sales (dollars)
25	6.52
12	3.75
15	4.25
22	5.45
19	2.05



Scatter Graph

A graph showing a scatter of points, each of which represents two characteristics of the same thing. For example, in the graph below, each point represents the number of pencils sold in the store and the number of pencils supplied by teachers in a certain week.

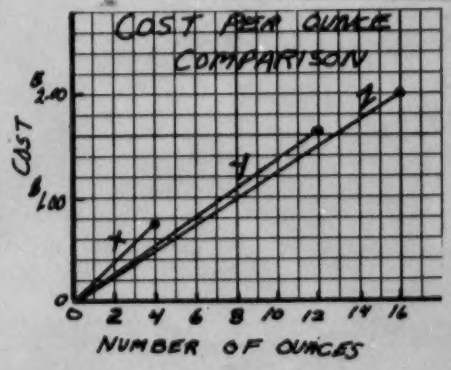
WEEK	NUMBER OF PENCILS GIVEN OUT BY TEACHER	NUMBER OF PENCILS SOLD
OCT. 1-5	55	10
OCT. 8-12	45	12
OCT. 15-19	40	18
OCT. 22-26	23	37
OCT 29-NOV 2	30	40



*Slope Diagram**

A graphical means of comparing fractions or ratios. To represent the ratio a/b, plot the point (b,a) and draw a line from (b,a) to the origin, (0,0). The slope of this line represents the ratio a/b. By comparing slopes of several lines, different ratios can be compared; the less steep the line, the smaller the ratio. For example, the diagram shows the ratio of price to weight for different brands of glue. The ratio of price to weight for Brand Z is smaller than that for Brands X or Y, and therefore, Brand Z costs the least per ounce.

BRAND	PRICE	WEIGHT (oz)
X	.75	4
Y	$1.62	12
Z	$2.00	16



Gross Profit

See *Profit*.

Histogram

See *Graph*.

Hypothesis

A tentative conclusion made in order to test its implications or consequences.

Inference

An assumption derived from facts or information considered to be valid and accurate.

Interest

A charge for borrowing money; generally a percentage of the amount borrowed.

Inventory

The quantity of goods or materials on hand.

Investment

The outlay of money for a future financial return.

Liability

A debt or obligation.

*Formerly called triangle diagram.

Marketing	The study or implementation of the most profitable and efficient methods of directing goods from manufacturer to consumer.
Market Research	The compilation of statistical information concerning consumers or purchasers.
Matrix	A chart of data arranged in rows or columns.
Mean	See *Average*.
Median	The middle value of a set of data in which the elements have been ordered from smallest to largest. The median value has as many elements above it as below it.
Merchandising	Identifying and meeting market needs in terms of products and subsequently stimulating a demand for products through advertising, promotion, and selling.
Mode	The element or elements in a set of data that occur most often.
Net Income	Profit for a given period.
Ordered Set	A set of data arranged from smallest to largest.
Per Cent	Literally per hundred. A ratio in which the denominator is always 100, e.g., 72 per cent = 72/100 = 0.72 = 72% , where the symbol % represents 1/100.
Percentage	A part of a whole expressed in hundredths.
Population	Any group of objects (e.g., people, animals, items) or events from which samples are taken for statistical measurement.
Profit	The excess of monetary returns over expenditures; the excess of the selling price of goods over their cost. (Often called net income.)
Gross Profit	The profit reported before deduction of the indirect costs of doing business.
Profit Margin	Profit expressed as a percentage of total sales revenue.

Proportion	A statement of equality of two ratios, i.e., the first term divided by the second term equals the third term divided by the fourth term, e.g., 5/10 = 1/2. Also a synonym for ratio: when two quantities are in direct proportion, their ratios are the same.
Quartile	
First	The first quartile is the value of the quarter-way piece of data in an ordered set of data.
Third	The third quartile is the value of the three-quarter-way piece of data in an ordered set of data.
Interquartile Range	The range or length of the middle 50% of an ordered set of data; the difference between the first and third quartile.
Range	Mathematical: the difference between the smallest and the largest values in a set of data.
Rank	To order the members of a set according to some criterion, such as size or importance. Example: to put pieces of data from smallest to largest.
Ratio	The quotient of two denominate numbers or values indicating the relationship in quantity, size, or amount between two different things. For example, the ratio of the number of children working on the assembly line to the number of items completed by them might be 12 children:17 items or $\frac{12 \text{ children}}{17 \text{ items}}$.
Recycle	To process a discarded item for reuse, either for its original purpose or for a new purpose.
Retail Price	The price level of goods sold in small quantity to the consumer.
Sample	A representative fraction of a population studied to gain information about the whole population.
Sample Size	The number of elements in a sample.
Scale	A direct proportion between two sets of dimensions (as between the dimensions in a drawing of a lab and the actual lab).

Scale Drawing	A drawing whose dimensions are in direct proportion to the object drawn.
Scale Model	A three-dimensional representation constructed to scale.
Set	A collection of characteristics, persons, or objects. Each thing in a set is called a member or an element.
Slope Diagram	See *Graph*.
Statistics	The science of drawing conclusions or making predictions using a collection of quantitative data.
Stock	A share in a company's assets and earnings.
Subcontractor	A company or a person who accepts part of a total contract or project from a general contractor or from a company that cannot do all the required work.
Tally	A visible record used to keep a count of some set of data, especially a record of the number of times one or more events occur. Example: a tally of survey results on customer preferences for three different designs of a product.
Wholesale Price	The price level of goods sold in large quantity to a merchant for resale.
Work	Work is done when a force is exerted through a distance. Work is the product of the force exerted and the distance moved.

E. Skills, Processes, and Areas of Study Utilized in School Supplies

The unique aspect of USMES is the degree to which it provides experience in the process of solving real problems. Many would agree that this aspect of learning is so important as to deserve a regular place in the school program even if it means decreasing to some extent the time spent in other important areas. Fortunately, real problem solving is also an effective way of learning many of the skills, processes, and concepts in a wide range of school subjects.

On the following pages are five charts and an extensive, illustrative list of skills, processes, and areas of study that are utilized in USMES. The charts rate School Supplies according to its potential for learning in various categories of each of five subject areas--real problem solving, mathematics, science, social science, and language arts. The rating system is based on the amount that each skill, process, or area of study within the subject areas is used--extensive (1), moderate (2), some (3), little or no use (-). (The USMES Guide contains a chart that rates all USMES units in a similar way.)

The chart for real problem solving presents the many aspects of the problem-solving process that students generally use while working on an USMES challenge. A number of the steps in the process are used many times and in different orders, and many of the steps can be performed concurrently by separate groups of students. Each aspect listed in the chart applies not only to the major problem stated in the unit challenge but also to many of the tasks each small group undertakes while working on a solution to the major problem. Consequently, USMES students gain extensive experience with the problem-solving process.

The charts for mathematics, science, social science, and language arts identify the specific skills, processes, and areas of study that may be learned by students as they respond to a School Supplies challenge and become involved with certain activities. Because the students initiate the activities, it is impossible to state unequivocally which activities will take place. It is possible, however, to document activities that have taken place in USMES classes and identify those skills and processes that have been used by the students.

Knowing in advance which skills and processes are likely to be utilized in School Supplies and knowing the extent that they will be used, teachers can postpone the teaching

of those skills in the traditional manner until later in the year. If the students have not learned them during their USMES activities by that time, they can study them in the usual way. Further, the charts enable a teacher to integrate USMES more readily with other areas of classroom work. For example, teachers may teach fractions during math period when fractions are also being learned and utilized in the students' USMES activities. Teachers who have used USMES for several successive years have found that students are more motivated to learn basic skills when they have determined a need for them in their USMES activities. During an USMES session the teacher may allow the students to learn the skills entirely on their own or from other students, or the teacher may conduct a skill session as the need for a particular skill arises.

Because different USMES units have differing emphases on the various aspects of problem solving and varying amounts of possible work in the various subject areas, teachers each year might select several possible challenges, based on their students' previous work in USMES, for their class to consider. This choice should provide students with as extensive a range of problems and as wide a variety of skills, processes, and areas of study as possible during their years in school. The charts and lists on the following pages can also help teachers with this type of planning.

Some USMES teachers have used a chart similar to the one given here for real problem solving as a record-keeping tool, noting each child's exposure to the various aspects of the process. Such a chart might be kept current by succeeding teachers and passed on as part of a student's permanent record. Each year some attempt could be made to vary a student's learning not only by introducing different types of challenges but also by altering the specific activities in which each student takes part. For example, children who have done mostly construction work in one unit may be encouraged to take part in the data collection and data analysis in their next unit.

Following the rating charts are the lists of explicit examples of real problem solving and other subject area skills, processes, and areas of study learned and utilized in School Supplies. Like the charts, these lists are based on documentation of activities that have taken place in USMES classes. The greater detail of the lists allows teachers to see exactly how the various basic skills, processes, and areas of study listed in the charts may arise in School Supplies.

The number of examples in the real problem solving list have been limited because the list itself would be unreasonably long if all the examples were listed for some of the categories. It should also be noted that the example(s) in the first category--*Identifying and Defining Problems*--have been limited to the major problem that is the focus of the unit. During the course of their work, the students will encounter and solve many other, secondary problems, such as the problem of how to display their data or how to draw a scale layout.

Breaking down an interdisciplinary curriculum like USMES into its various subject area components is a difficult and highly inexact procedure. Within USMES the various subject areas overlap significantly, and any subdivision must be to some extent arbitrary. For example, where does measuring as a mathematical skill end and measurement as science and social science process begin? How does one distinguish between the processes of real problem solving, of science, and of social science? Even within one subject area, the problem still remains--what is the difference between graphing as a skill and graphing as an area of study? This problem has been partially solved by judicious choice of examples and extensive cross-referencing.

Because of this overlap of subject areas, there are clearly other outlines that are equally valid. The scheme presented here was developed with much care and thought by members of the USMES staff with help from others knowledgeable in the fields of mathematics, science, social science, and language arts. It represents one method of examining comprehensively the scope of USMES and in no way denies the existence of other methods.

REAL PROBLEM SOLVING	Overall Rating
Identifying and defining problem.	1
Deciding on information and investigations needed.	1
Determining what needs to be done first, setting priorities.	1
Deciding on best ways to obtain information needed.	1
Working cooperatively in groups on tasks.	1
Making decisions as needed.	1
Utilizing and appreciating basic skills and processes.	1
Carrying out data collection procedures--observing, surveying, researching, measuring, classifying, experimenting, constructing.	1
Asking questions, inferring.	1
Distinguishing fact from opinion, relevant from irrelevant data, reliable from unreliable sources.	1

REAL PROBLEM SOLVING	Overall Rating
Evaluating procedures used for data collection and analysis. Detecting flaws in process or errors in data.	1
Organizing and processing data or information.	1
Analyzing and interpreting data or information.	1
Predicting, formulating hypotheses, suggesting possible solutions based on data collected.	1
Evaluating proposed solutions in terms of practicality, social values, efficacy, aesthetic values.	1
Trying out various solutions and evaluating the results, testing hypotheses.	1
Communicating and displaying data or information.	1
Working to implement solution(s) chosen by the class.	1
Making generalizations that might hold true under similar circumstances; applying problem-solving process to other real problems.	1

KEY: 1 = extensive use, 2 = moderate use, 3 = some use, - = little or no use

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MATHEMATICS	Overall Rating
Basic Skills	
Classifying/Categorizing	1
Counting	1
Computation Using Operations	
Addition/Subtraction	1
Multiplication/Division	1
Fractions/Ratios/Percentages	1
Business and Consumer Mathematics/ Money and Finance	1
Measuring	1
Comparing	2
Estimating/Approximating/Rounding Off	1
Organizing Data	1
Statistical Analysis	1
Opinion Surveys/Sampling Techniques	2
Graphing	1
Spatial Visualization/Geometry	2
Areas of Study	
Numeration Systems	1
Number Systems and Properties	1
Denominate Numbers/Dimensions	1
Scaling	3
Symmetry/Similarity/Congruence	-
Accuracy/Measurement Error/ Estimation/Approximation	1
Statistics/Random Processes/Probability	1
Graphing/Functions	1
Fraction/Ratio	1
Maximum and Minimum Values	3
Equivalence/Inequality/Equations	2
Money/Finance	1
Set Theory	2

SCIENCE	Overall Rating
Processes	
Observing/Describing	1
Classifying	2
Identifying Variables	3
Defining Variables Operationally	3
Manipulating, Controlling Variables/ Experimenting	3
Designing and Constructing Measuring Devices and Equipment	2
Inferring/Predicting/Formulating, Testing Hypotheses/Modeling	1
Measuring/Collecting, Recording Data	1
Organizing, Processing Data	1
Analyzing, Interpreting Data	1
Communicating, Displaying Data	1
Generalizing/Applying Process to New Problems	1
Areas of Study	
Measurement	2
Motion	-
Force	3
Mechanical Work and Energy	-
Solids, Liquids, and Gases	2
Electricity	-
Heat	-
Light	-
Sound	-
Animal and Plant Classification	-
Ecology/Environment	3
Nutrition/Growth	-
Genetics/Heredity/Propagation	-
Animal and Plant Behavior	-
Anatomy/Physiology	-

KEY: 1 = extensive use, 2 = moderate use, 3 = some use, - = little or no use

SOCIAL SCIENCE	Overall Rating
Process	
Observing/Describing/Classifying	1
Identifying Problems, Variables	1
Manipulating, Controlling Variables/ Experimenting	3
Inferring/Predicting/Formulating, Testing Hypotheses	1
Collecting, Recording Data/Measuring	2
Organizing, Processing Data	2
Analyzing, Interpreting Data	2
Communicating, Displaying Data	2
Generalizing/Applying Process to Daily Life	1
Attitudes/Values	
Accepting responsibility for actions and results	1
Developing interest and involvement in human affairs	1
Recognizing the importance of individual and group contributions to society	1
Developing inquisitiveness, self-reliance, and initiative	1
Recognizing the values of cooperation, group work, and division of labor	1
Understanding modes of inquiry used in the sciences, appreciating their power and precision	1
Respecting the views, thoughts, and feelings of others	1
Being open to new ideas and information	1
Learning the importance and influence of values in decision making	1
Areas of Study	
Anthropology	-
Economics	1
Geography/Physical Environment	-
Political Science/Government Systems	1
Recent Local History	3
Social Psychology/Individual and Group Behavior	3
Sociology/Social Systems	2

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LANGUAGE ARTS	Overall Rating
Basic Skills	
Reading	
Literal Comprehension: Decoding Words, Sentences, Paragraphs	1
Critical Reading: Comprehending Meanings, Interpretation	2
Oral Language	
Speaking	1
Listening	1
Memorizing	-
Written Language	
Spelling	2
Grammar: Punctuation, Syntax, Usage	2
Composition	2
Study Skills	
Outlining/Organizing	1
Using References and Resources	2
Attitudes/Values	
Appreciating the value of expressing ideas through speaking and writing	1
Appreciating the value of written resources	1
Developing an interest in reading and writing	2
Making judgments concerning what is read	2
Appreciating the value of different forms of writing, different forms of communication	1

KEY: 1 = extensive use, 2 = moderate use,
3 = some use, - = little or no use

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REAL PROBLEM SOLVING IN SCHOOL SUPPLIES

Identifying and Defining Problem	• Students decide that there might be a need for a place in school where students and teachers can buy things they need. • See also SOCIAL SCIENCE list: *Identifying Problems, Variables.*
Deciding on Information and Investigations Needed	• Students decide to find out what things people would buy, whether they can get permission to operate a school store, how much different items would cost, and where they can get money to start the store.
Determining What Needs to Be Done First, Setting Priorities	• Students decide to find out what things people would buy and to determine costs of various items before asking permission from the principal.
Deciding on Best Ways to Obtain Information Needed	• Students decide to design and distribute a written survey to obtain information about things students and teachers would buy. • Students decide to phone school supply outlets to obtain catalogs quickly.
Working Cooperatively in Groups on Tasks	• Students form groups to (1) design survey, (2) check catalogs for prices of supplies, and (3) investigate possible locations for the store.
Making Decisions as Needed	• Students decide to give the survey to five students in each class, determining specific students by picking every fifth name from each class list. • Students decide that the best place for the store is in the corridor outside their room. • Students decide to try to obtain a loan from the PTA for their first order of supplies. • Students decide on quantities of supplies to order based on plans for payment. • Students decide on plans to operate store. • Students decide to present their findings to the principal when asking for permission.

Utilizing and Appreciating Basic Skills and Processes	• Students tally results of survey and make a bar graph to show the results clearly. • Students calculate cost per unit, price they will charge, and profit realized. • Students design a display case and a security system for the case. • Students recognize that people's needs and tastes vary. • Students find that comparative shopping is worthwhile. • Students discover that questions on a survey must be worded clearly and must elicit the type of information they need. • Students present their findings to the principal and to the PTA.
Carrying Out Data Collection Procedures--Opinion Surveying, Researching, Measuring, Classifying, Experimenting, Constructing	• Students conduct a survey to determine which items students will buy. • Students collect data on costs from three catalogs. • Students measure wood available for display case. • Students classify results of survey according to grade level. • Students keep records of sales in order to determine future orders of supplies. • Students construct a display case. • See also MATHEMATICS list: *Classifying/Categorizing; Measuring.* • See also SCIENCE list: *Observing/Describing; Classifying; Manipulating, Controlling Variables/Experimenting; Designing and Constructing Measuring Devices and Equipment; Measuring/Collecting, Recording Data.* • See also SOCIAL SCIENCE list: *Observing/Describing/Classifying; Manipulating, Controlling Variables/Experimenting; Collecting, Recording Data/Measuring.*
Asking Questions, Inferring	• Students ask whether the results of the survey reflect the intentions of the whole school. They infer that they do from the similarity of results among the same grade level classes. • Students ask whether students in all grade levels would buy the same items. They infer from the survey results that pens are more popular in upper grades than in lower grades. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses/Modeling.* • See also SOCIAL SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*

Distinguishing Fact from Opinion, Relevant from Irrelevant Data, Reliable from Unreliable Sources	• Students recognize that results from a survey are better than their own opinions about what people would buy. • Students recognize that information on costs of large quantities from catalogs is more relevant than costs in local stores.
Evaluating Procedures Used for Data Collection and Analysis, Detecting Flaws in Process or Errors in Data	• Students evaluate procedures for keeping track of receipts and determine that there is a better way. • Students determine that errors have been made in calculating total costs. • Students determine that the inventory has to be checked each week and compared with sales. • See also MATHEMATICS list: *Estimating/Approximating/Rounding Off.*
Organizing and Processing Data	• Students record prices from the catalogs on a chart. • Students make graphs of survey data. • Students record purchases and sales on an inventory chart. • Students record payments and receipts in an account book. • See also MATHEMATICS list: *Organizing Data.* • See also SCIENCE and SOCIAL SCIENCE lists: *Organizing, Processing Data.*
Analyzing and Interpreting Data	• Students determine from their graphs which items to sell. • Students determine by comparison of costs and discounts available which school supplier to use. • Students determine from their survey results and inventory what quantities of each item to order. • Students determine which items they need to advertise in order to promote sales. • See also MATHEMATICS list: *Comparing; Statistical Analysis; Opinion Surveys/Sampling Techniques; Graphing; Maximum and Minimum Values.* • See also SCIENCE and SOCIAL SCIENCE lists: *Analyzing/Interpreting Data.*
Predicting, Formulating Hypotheses, Suggesting Possible Solutions Based on Data Collected	• Students hypothesize that sales of certain items will be heaviest in certain months. • Students suggest that the store be open for a half-hour every morning based on restrictions in school schedule. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses/Modeling.* • See also SOCIAL SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*

Evaluating Proposed Solutions in Terms of Practicality, Social Values, Efficacy, Aesthetic Values	• Students decide that operating a small store is the best way to make a few needed items available to students and teachers. • Students agree that everyone should have a chance to work in the store but that certain people should be in charge of keeping records. • Students feel that it is important to have an attractive display case.
Trying Out Various Solutions and Evaluating the Results, Testing Hypotheses	• Students run the store for a month and evaluate procedures, items purchased, and profits. • Students conduct a survey to find out if there is a demand for continuing operation of the store and which items should be added to or maintained on the store inventory. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses/Modeling.* • See also SOCIAL SCIENCE list: *Inferring/Predicting/ Formulating, Testing Hypotheses.*
Communicating and Displaying Data or Information	• Students report to the class about their findings and progress in their jobs. • Students prepare graphs and written reports of their store operations for the principal and PTA.
Working to Implement Solution(s) Chosen by the Class	• Students sell items needed by students and teachers in a school store for the whole year.
Making Generalizations That Might Hold True Under Similar Circumstances; Applying Problem-Solving Process to Other Real Problems	• Students apply skills acquired in determining costs and in buying and selling to similar activities in their daily lives. • Students apply scientific inquiry process learned to other real problems. • See also SCIENCE list: *Generalizing/Applying Process to New Problems.* • See also SOCIAL SCIENCE list: *Generalizing/Applying Process to Daily Life.*

ACTIVITIES IN SCHOOL SUPPLIES UTILIZING MATHEMATICS

Basic Skills

Classifying/Categorizing	• Classifying available supplies according to characteristics. • Classifying results of opinion surveys according to grade level. • Categorizing objects in more than one way, e.g., for more than one purpose. • Using the concepts of sets (subsets, unions, intersections, set notation) e.g., set of students, set of supplies.
Counting	• Counting and tallying survey data, questionnaire data on preferences for particular supplies. • Counting number of items in inventory, number of orders received, number of people who attend opening of store. • Counting to read scales on measuring instruments, such as rulers, weighing scales. • Counting by sets to find scale for graph axes.
Computation Using Operations: Addition/Subtraction	• Adding one-, two-, or three-digit whole numbers to find total tally of items in stock or total measurement of dimensions for display case. • Adding minutes and seconds when timing length of oral advertisements, announcements for school supply center. • Subtracting to find differences between predicted and actual demand for supplies. • Subtracting one-, two-, or three-digit whole numbers to find range of measurements or counts.
Computation Using Operations: Multiplication/Division	• Multiplying and dividing to determine preference ratings from a survey. • Multiplying to find total amount of supplies needed, total dimensions of space needed for storage or sales areas. • Multiplying or dividing to convert one unit of measure to another, such as inches to feet. • Dividing to calculate averages such as average order received per week. • Dividing to find ratios, fractions or percentages such as percentage of certain responses to survey according to grade level. • Multiplying or dividing to find scale for graph axes.

Computation Using Operations: Fractions/Ratios/Percentages	• Using mixed numbers to perform calculations, such as determining amount of Tri-Wall needed for display case or storage containers. • Changing fractions to higher or lower terms to perform operations. • Using fractions in measurement, graphing. • Calculating percentages from survey data, percentage of supplies used per week, per month. • Using slope diagrams to compare ratios, such as number of items per package.
Computation Using Operations: Business and Consumer Mathematics/ Money and Finance	• Adding and subtracting dollars and cents to perform cost analysis, to figure profit or loss for various items sold in school store. • Multiplying to find total cost of supplies ordered. • Dividing to find unit cost, such as cost per pencil, while buying a gross or some other large amount. • Using slope diagrams to compare unit costs. • Comparing prices of items listed in different catalogs. • Calculating percentage of profit. • Calculating sales price according to percentage of discount.
Measuring	• Using different standard units to measure sizes of materials received, such as sizes of carpet pieces, cardboard scraps. • Measuring size of storage area, display case, and smaller storage containers. • Timing oral announcements. • See also SCIENCE list: *Measuring/Collecting, Recording Data.* • See also SOCIAL SCIENCE list: *Collecting, Recording Data, Measuring.*
Comparing	• Using the concept of "greater than" and "less than" in making comparisons, e.g., the sizes of collected goods, such as bottles, boxes. • Comparing data gathered from various sources such as survey data from different grade levels. • Comparing estimated and actual requests for particular items, estimated and actual number of items collected. • Making graphic comparisons of fractions and ratios. • Comparing number of items sold before and during a sale on an item, before and after advertising the school store.

Comparing (cont.)	• Comparing survey results before and after a numerical preference rating is calculated for each item. • See also SCIENCE list: *Analyzing, Interpreting Data.* • See also SOCIAL SCIENCE list: *Analyzing, Interpreting Data.*
Estimating/Approximating/Rounding Off	• Estimating error in survey data on customer preference for particular items. • Estimating the number of people who will request a product, who will donate discarded items, who will be needed for storing supplies. • Determining when a measurement is likely to be accurate enough for a particular purpose. • Rounding off measurements according to accuracy required.
Organizing Data	• Tallying results of survey on bar graph form. • Ordering survey results on types of supplies that students and teachers prefer. • Ordering standard units of measure in terms of size, such as inch, foot, yard or centimeter, meter. • Ordering numbers on graph axes. • Ordering quantities of different items sold. • See also SCIENCE list: *Organizing, Processing Data.* • See also SOCIAL SCIENCE list: *Organizing, Processing Data.*
Statistical Analysis	• Interpreting graphs. • Calculating average number of various items sold or distributed per week, per month. • Determining maximum and minimum space needed for storage. • Assessing the accuracy of an estimate based on a sample survey or on a short period of operation of the school store. • See also SCIENCE list: *Analyzing, Interpreting Data.* • See also SOCIAL SCIENCE list: *Analyzing, Interpreting Data.*
Opinion Surveys/Sampling Techniques	• Conducting opinion surveys on items that people would buy from school store, items that would be requested from recycling center. • Defining makeup and size of sample. • Devising method to obtain quantitative information (preference rating) from opinion surveys.

Opinion Surveys/Sampling Techniques (cont.)

- Evaluating survey: questions asked, size and makeup of sample.
- Evaluating accuracy of survey results.
- See also SCIENCE list: *Analyzing, Interpreting Data.*
- See also SOCIAL SCIENCE list: *Analyzing, Interpreting Data.*

Graphing

- Using alternative methods of displaying data, such as charts, graphs.
- Making a graph form--dividing axes into parts, deciding on an appropriate scale.
- Putting data on graph forms.
- Obtaining information from graphs.
  - Bar graph--number of students who would buy certain items vs. items on survey.
  - Histogram--number of notebooks sold in a week vs. number of weeks.
  - Line graph--number of customers in a day vs. amount of sales.
  - Line chart--number of students in primary and in intermediate grades who would buy certain items.
  - Conversion graph--inches vs. feet.
  - Scatter graph--number of pencils sold in school store each week vs. number of pencils supplied by school during those weeks.
  - Cumulative distribution graph--number of notebooks sold in a week vs. a certain number of weeks or less.
  - Slope diagram--cost of items vs. number in package.
- See also SCIENCE list: *Communicating, Displaying Data.*
- See also SOCIAL SCIENCE list: *Communicating, Displaying Data.*

Spatial Visualization/Geometry

- Constructing and using geometric figures, for example, triangles, circles, to use in construction of storage containers, advertising posters.
- Using geometric figures to understand and utilize relationships, such as area, volume, similarity, congruence, when describing properties of collected materials.
- Deriving information from maps of school.
- Making flow diagram for distribution or sales area.

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Areas of Study	
Numeration Systems	• Using decimal system in measuring length (m, cm). • Using fractions in measuring length (parts of inches, feet, or yards). • Using decimal system in calculating costs, profits, losses, etc.
Number Systems and Properties	• See *Computation Using Operations*.
Denominate Numbers/Dimensions	• See *Measuring*.
Scaling	• Using maps of school to decide on areas for storage and sale. • Recognizing relationships among units of measure, e.g., inch, foot, yard or centimeter, meter, kilometer.
Symmetry/Similarity/Congruence	• See *Spatial Visualization/Geometry*.
Accuracy/Measurement Error/ Estimation/Approximation	• See *Measuring* and *Estimating/Approximating/Rounding Off*.
Statistics/Random Processes/ Probability	• See *Statistical Analysis*.
Graphing/Functions	• See *Graphing*.
Fraction/Ratio	• See *Computation Using Operations: Fractions/Ratios/ Percentages*.
Maximum and Minimum Values	• Finding the shortest daily time for school store operation for maximum benefit. • Maximizing profit by considering both price and number that can be sold at a given price. • Maximizing sales by trying out various arrangements of items in display case. • Using slope diagram to find minimum cost per item.

Maximum and Minimum Values (cont.)	• Maximizing sales by trying various locations for school store. • Minimizing storage space by trying out various arrangements of supplies.
Equivalence/Inequality/Equations	• See *Comparing* and *Computation Using Operations*.
Money/Finance	• See *Computation Using Operations: Business and Consumer Mathematics/Money and Finance*.
Set Theory	• See *Classifying/Categorizing*.

ACTIVITIES IN SCHOOL SUPPLIES UTILIZING SCIENCE

Process

Observing/Describing	• Observing that many supplies are needed and not available for projects in different classes, e.g., bottles, bags, boxes, egg cartons, trays, yarn. • Observing and describing various areas for storage or for location of school store (or recycling center). • See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying*.
Classifying	• Determining which supplies are best, usable, or of little use for certain purposes. • Determining allocation of supplies according to need, alternative uses. • See also MATHEMATICS list: *Classifying/Categorizing*. • See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying*.
Identifying Variables	• Identifying variables of size, shape, type of material, availability, durability, storability in determining possible uses for supplies. • Identifying variables of location (accessibility), amount of space (length, width, height), in choosing storage area for supplies. • See also SOCIAL SCIENCE list: *Identifying Problems/ Variables*.
Defining Variables Operationally	• Defining accessibility of storage space as distance from entrances where supplies would arrive, distance from classroom for easy supervision, and availability to other classrooms. • Defining amount of space in possible storage as number of square meters of wall space for storage and number of square meters of floor space for sorting materials. • Defining various sizes and shapes needed for specific uses. • Defining various types of materials in terms of need as for holding liquids and solids, for being transparent, for durability, flexibility, absorbency, etc.

Manipulating, Controlling Variables/Experimenting	• Determining, by testing, size and shape of supplies usable for certain purposes. • Determining, by testing, degree of transparency of different materials. • Determining, by testing, amount of durability, flexibility, absorbency, etc. • Using the same amount of material, the same time period, the same weight, etc., in each test. • Trying different arrangements of storage area to determine most efficient in terms of space used and availability of items frequently requested. • See also SOCIAL SCIENCE list: *Manipulating, Controlling, Variables/Experimenting.*
Designing and Constructing Measuring Devices and Equipment	• Constructing shelves for storage area. • Constructing counter for entrance to storage area. • Constructing test equipment to determine durability, flexibility of items.
Inferring/Predicting/Formulating, Testing Hypotheses/Modeling	• Inferring from tests that certain materials are good for certain uses. • Predicting that certain supplies will be needed more than others. • Hypothesizing that a certain arrangement of materials will make them fit more compactly in a certain space; trying out several possible arrangements and determining amount of space used. • Making a diagram of supply area showing flow of materials. • See also SOCIAL SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*
Measuring/Collecting, Recording Data	• Collecting data on supplies received and distributed. • Timing oral announcements using a stopwatch. • Measuring storage area to determine space available. • Measuring durability, absorbency, transparency of items. • Reading measuring devices accurately. • Recording data in chart form. • See also MATHEMATICS list: *Measuring.* • See also SOCIAL SCIENCE list: *Collecting, Recording Data/Measuring.*

Organizing, Processing Data	• Ordering repeated measurements from smallest to largest. • Recording on inventory sheet amount of supplies obtained and amount distributed. • Recording measurements of space on sketch of storage area. • See also MATHEMATICS list: *Organizing Data*. • See also SOCIAL SCIENCE list: *Organizing, Processing Data*.
Analyzing, Interpreting Data	• Finding the median of repeated measurements. • Determining which supplies are best for certain purposes according to test data and graphs. • Determining from inventory chart when more supplies will be needed. • Determining best arrangements of supplies in storage area. • See also MATHEMATICS list: *Comparing; Statistical Analysis; Opinion Surveys/Sampling Techniques; Graphing; Maximum and Minimum Values*.
Communicating, Displaying Data	• Drawing graphs and flow diagrams to communicate data. • See also MATHEMATICS list: *Graphing*. • See also SOCIAL SCIENCE list: *Communicating, Displaying Data*. • See also LANGUAGE ARTS list.
Generalizing/Appling Process to New Problems	• Applying skills learned to problems arising in operating a school store or determining which supplies a school should buy. • Applying inquiry process learned to other types of problems. • See also SOCIAL SCIENCE list: *Generalizing/Applying Process to Daily Life*.
Areas of Study	
Measurement	• Using standard units (e.g., meters) and nonstandard units (e.g., children's feet) to measure size of sales area or storage area. • Using standard and nonstandard units to measure volume, durability, transparency, etc., of items. • Reading measuring devices accurately. • See also *Designing and Constructing Measuring Devices and Equipment*. • See also MATHEMATICS list: *Measuring*.

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Motion	
Speed/Velocity	• Observing that the speed of an object affects the amount of impact the object has on another object when dropping objects from different heights to test durability of materials.
Force	• Observing that force must be applied to hammer nails into wood. • Observing that machines multiply the force that is exerted, e.g., a hammer multiplies the force exerted by a person.
Weight	• Observing that items differ in weight. • Observing that weight is a force due to the gravitational pull of the earth on objects. • Observing that strength (of items, of shelves, etc.) can be determined as resistance to another force (weight).
Friction	• Observing that some supplies roll more easily on tilted surfaces than others.
Mechanical Work and Energy	• Noting that work is done and energy expended when nails are pounded into wood. • Observing that electrical energy is converted into the mechanical energy of saber saws, electric drills. • Observing that sanding wood generates heat as mechanical energy is transformed into heat energy. • See also *Motion* and *Force*.
Solids, Liquids, and Gases	
States of Matter	• Observing that glue is available in solid and liquid forms with different properties. • Observing that heat from a hot glue gun changes a solid stick of glue into liquid glue.
Properties of Matter	• Observing that different materials (bottles, boxes, string) have different properties that make them useful for different purposes.

Heat	• Observing that glue guns, saber saws, and electric drills generate heat as electrical energy is transformed into mechanical energy and heat energy.
Light	• Observing that signs promoting use of school store or distribution center are more easily read if placed in well-lighted areas. • Observing that supplies are difficult to see if placed against backgrounds with a similar color, but easy to see if placed against a background of a contrasting color (e.g., yellow objects against a blue background). • Observing that a glare is produced when a light source shines directly on a display case. • Observing that light passes through certain materials that are transparent and does not pass through materials that are opaque.
Sound	• Observing that some of the electrical energy supplied to saber saws and power drills is transformed into sound energy (noise).

ACTIVITIES IN SCHOOL SUPPLIES UTILIZING SOCIAL SCIENCE

Process	
Observing/Describing/Classifying	• Observing that students forget to bring to school things that they need, such as pencils, notebooks, erasers, folders. • Observing that sometimes the right kind of paper is not available for class use. • Classifying groups of people according to similarities (age, sex) in order to choose a stratified sample for an opinion survey. • See also MATHEMATICS list: *Classifying/Categorizing.* • See also SCIENCE list: *Observing/Describing; Classifying.*
Identifying Problems, Variables	• Identifying problems in setting up a school store: items to sell, place for store, permission, store hours, etc. • Identifying variables of need, cost, and money available in determining items to buy for school store. • Identifying problems in researching kinds of supplies used in school and kinds of supplies wasted. • Identifying variables that affect the results of an opinion survey, e.g., grade level of students, day of week, habits of students. • See also SCIENCE list: *Identifying Variables.*
Manipulating, Controlling Variables/ Experimenting	• Designing opinion surveys for both students and teachers to determine need for supplies. • Collecting information on survey about variables that affect survey results, such as grade level of students. • Using stratified sample for student survey. • Checking various sources to determine costs of supplies. • Investigating possible sources of money for supplies. • See also SCIENCE list: *Identifying Variables.*
Inferring/Predicting/Formulating, Testing Hypotheses	• Inferring from two samples of students that the results of the survey reflect the opinions of all students. • Hypothesizing that certain items will be sold faster than others. Keeping and analyzing records of sales. • Hypothesizing that less paper will be wasted if the type available fits the need. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*

Collecting, Recording Data/ Measuring	• Counting and tallying votes to set priorities and determine action to be taken. • Recording results of opinion surveys. • Recording data on costs of supplies from different sources. • Recording data on amount of money available from different sources. • Recording data on amount and type of paper used and wasted by each grade. • See also MATHEMATICS list: *Counting; Measuring.* • See also SCIENCE list: *Measuring/Collecting, Recording Data.*
Organizing, Processing Data	• Ordering results of opinion survey from most popular items to least popular. • Ordering costs of supplies from most expensive source to least expensive source. • Ordering paper usage and wastage according to grade level. • See also MATHEMATICS list: *Organizing Data.* • See also SCIENCE list: *Organizing, Processing Data.*
Analyzing, Interpreting Data	• Analyzing graphs of data from survey on items needed. • Comparing survey data obtained from different groups of people or from samples of different size. • Evaluating the way the survey was administered, the size and makeup of the sample. • Assessing the accuracy of the survey results. • Analyzing paper wastage according to grade level and use of paper. • Deciding on best source of supplies and money according to data collected. • See also MATHEMATICS list: *Comparing; Statistical Analysis; Opinion Surveys/Sampling Techniques; Graphing; Maximum and Minimum Values.* • See also SCIENCE list: *Analyzing, Interpreting Data.*
Communicating, Displaying Data	• Making charts or graphs that can be easily understood and have maximum impact on audience. • Presenting data to principal, school board. • See also MATHEMATICS list: *Graphing.* • See also SCIENCE list: *Communicating, Displaying Data.* • See also LANGUAGE ARTS list.

Generalizing/Applying Process to Daily Life	• Applying one's knowledge of comparative shopping and marketing to help solve other problems in daily life. • Using one's knowledge about opinion surveys to conduct other surveys. • See also SCIENCE list: *Generalizing/Applying Process to New Problems*.
Attitudes/Values	
Accepting Responsibility for Actions and Results	• Making sure that various tasks (e.g., collecting data, sorting materials) are done. • Arranging schedules with other classes for convenient times for surveys, for school store hours. • Scheduling personnel for school store, recycling center. • Scheduling and giving presentations of plans to principal, teachers, school board. • Being responsible for actions during trips to stores, visits to other classes, operation of school store and/or recycling center.
Developing Interest and Involvement in Human Affairs	• Setting up school store to provide items students and teachers need. • Recognizing that students will be more interested in school activities if adequate materials are available.
Recognizing the Importance of Individual and Group Contributions to Society	• Recognizing that many individual and group efforts are required to operate a school store or recycling center.
Developing Inquisitiveness, Self-Reliance, and Initiative	• Finding own solutions to problems encountered. • Dealing with people in obtaining supplies. • Finding different ways to obtain and convey information, e.g., writing letters, telephoning. • Conducting group sessions and reporting to class on group work. • Choosing the best way to present plans to principal, school board.
Recognizing the Values of Cooperation, Group Work, and Division of Labor	• Finding that group work proceeds smoothly when everyone cooperates. • Finding that various jobs in the school store or recycling center need to be done by different people or groups.

Understanding Modes of Inquiry Used in the Sciences, Appreciating Their Power and Precision	• Recognizing the importance of obtaining information from others. • Recognizing that schedules can be made, items ordered, and recommendations made based on information collected. • Recognizing that others are more open to ideas if adequate information is given. • See also MATHEMATICS and SCIENCE lists.
Respecting the Views, Thoughts, and Feelings of Others	• Conducting opinion surveys to determine need for items. • Considering all suggestions and assessing their merit. • Recognizing that people's opinions vary.
Being Open to New Ideas and Information	• Considering alternative ways of doing specific tasks. • Asking other members of class for ideas and suggestions. • Writing, visiting, or calling various businesses.
Learning the Importance and Influence of Values in Decision Making	• Recognizing that preferences for various items reflect individual needs and tastes. • Recognizing that school store hours are determined by the value placed by students and teachers on certain times of day and on the need for supplies.
Areas of Study	
Economics	• Gaining experience in comparative shopping for materials, record keeping, figuring profit margin, inventory control. • Using economic concepts and terms, for example, cost, profit, advertising cost, wholesale price, discount, retail price, etc., when purchasing school supplies in quantity. • Analyzing variables affecting consumer purchases, commercial sales. • Investigating economics of production and marketing; cost analysis. • Gaining experience with finance: sources, uses, and limitations of revenues for the purchase of school supplies. • Assessing preferences, characteristics, etc., of possible consumers through surveys, questionnaires. • Investigating costs of materials needed for display case, storage containers, advertising campaign vs. use of materials and budget restrictions.

Geography/Physical Environment	• Making and using sketches of school to determine best location for school store or recycling center. • Investigating differences in costs of materials due to location of manufacturer/supplier.
Political Science/Government Systems	• Obtaining permission to operate a school store, recycling center. • Working with school authorities to determine better management of school supplies. • Determining need for rules and regulations when school supplies center is open for business. • Investigating regulations and policies affecting a planned course of action, such as charging tax for supplies sold in school store. • Getting in touch with and working with school authorities, local industries concerned with reuse of discarded materials.
Recent Local History	• Investigating previous methods used to make needed supplies available to students and teachers. • Investigating previous attempts to make supplies available by means of a school store or recycling center. • Investigating previous school orders for paper, other supplies.
Social Psychology/Individual and Group Behavior	• Developing a gimmick to advertise school store opening. • Recognizing and using different methods to approach different groups such as students, parents, principal, school board. • Recognizing varying abilities of individuals for various roles within groups. • Analyzing the effects of a small group making decisions for a larger group. • Assessing the effects of group action in making recommendations about redistribution of school supplies.
Sociology/Social System	• Devising a method to work cooperatively in small and large groups. • Considering the integral nature of school as a factor in obtaining and distributing supplies.

ACTIVITIES IN SCHOOL SUPPLIES UTILIZING LANGUAGE ARTS

Basic Skills

Reading: Literal Comprehension--Decoding Words, Sentences, and Paragraphs	• Decoding words and sentences when reading catalogs of school supplies, drafts of letters and surveys, Yellow Pages of telephone books, reports on work progress.
Reading: Critical Reading--Comprehending Meanings, Interpretation	• Evaluating drafts of letters, surveys, reports. • Following directions when filling out an order form.
Oral Language: Speaking	• Reporting group activities to class; responding to criticisms of activities. • Responding to questions from principal, PTA, customers. • Preparing effective oral presentations of survey questions, methods, findings, and suggested solutions. • Offering suggestions and criticisms during small group work and class discussions on problems and proposed solutions. • Using the telephone properly and effectively. • Using rules of grammar in speaking.
Oral Language: Listening	• Listening to group reports. • Listening to answers to oral survey questions. • Listening to customer inquiries, orders, complaints. • Following spoken directions.
Oral Language: Memorizing	• Memorizing portions of oral presentation.
Written Language: Spelling	• Using correct spelling in writing.
Written Language Grammar--Punctuation, Syntax, Usage	• Using rules of grammar in writing.

Written Language: Composition	• Writing letters to school authorities to obtain permission to establish a supply center, letters to school supply outlets and manufacturers to obtain supplies. • Writing opinion surveys, devising questions to elicit desired information, judging whether a question is clear. • Writing posters, flyers, public address announcements about school store or recycling center.
Study Skills: Outlining/Organizing	• Taking notes. • Developing opinion survey; organizing questions. • Outlining data collection schemes, presentations, drafts of letters, reports.
Study Skills: Using References and Resources	• Researching regulations and factors affecting the purchases of supplies from catalogs, the sale of supplies in a school store. • Investigating effect of different forms of communication on people (public address system announcements, posters, flyers, ads in school newspaper or bulletin). • Using "How To" materials for information on graphing, measuring skills, etc.
Attitudes/Values	
Appreciating the Value of Expressing Ideas Through Speaking and Writing	• Finding that a letter or phone conversation evokes a response from people, e.g., principal, manufacturers, suppliers. • Finding that a newsletter item or report on school store or recycling center is an effective way of communicating with other people.
Appreciating the Value of Written Resources	• Finding that desired information can be found in telephone books, catalogs, magazines, etc.
Developing an Interest in Reading and Writing	• Seeking out written resources that will help in solving problems. • Reading with interest catalogs, advertisements, information on packages.

Making Judgments Concerning What is Read	• Deciding on reliability of information: what the basis is for facts or opinions stated.
Appreciating the Value of Different Forms of Writing, Different Forms of Communication	• Finding that the best method for conveying (or communicating) information is determined in part by the audience to whom the message is directed. • Finding that certain data or information can be best conveyed by writing it down, preparing graphs or charts, etc. • Finding that certain data or information should be written down so that it can be referred to at a later time. • Finding that spoken instructions are sometimes better than written instructions, and vice versa.